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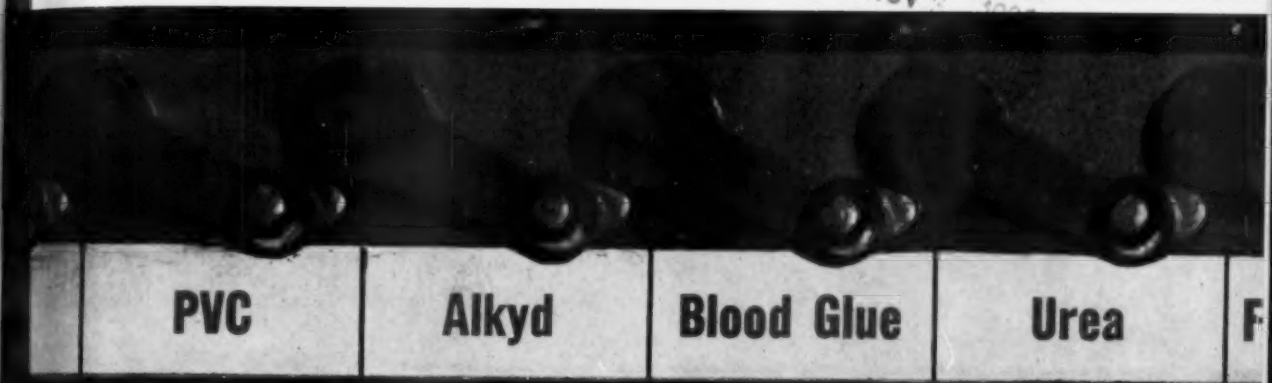
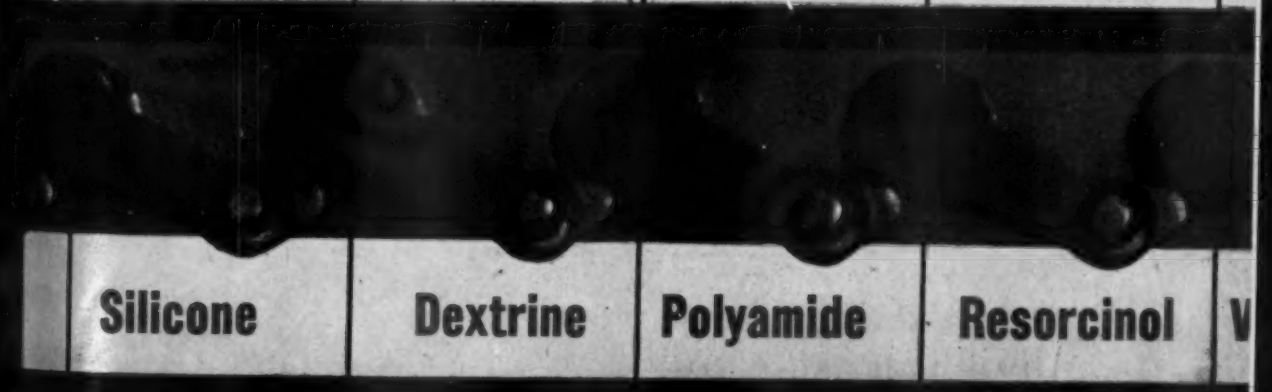
ADHESIVES AGE

MANUFACTURE, APPLICATION, TECHNOLOGY, RESEARCH AND MARKETING

EMBER, 1960

THE UNIVERSITY OF MICHIGAN





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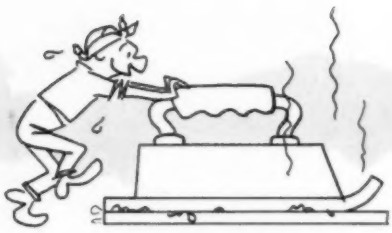

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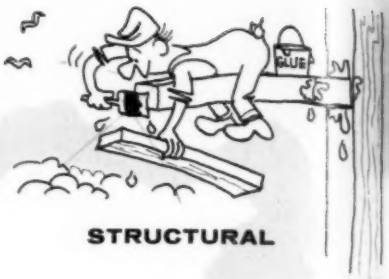

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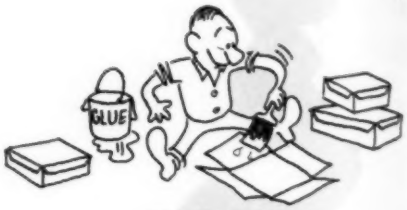

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1. Provides a large list of tested adhesives with unusual properties immediately available to every industry.

2. Constant production of successful new adhesives means accumulation of knowhow at an exponential rate and makes American Latex an ideal source for technical consultation on any adhesive problem.

You are invited to contact American Latex for a survey of your own adhesive needs and an analysis of how "specific purpose" Stabonds might cut costs, improve quality, speed production, and save labor.

Footrests Bonded Successfully

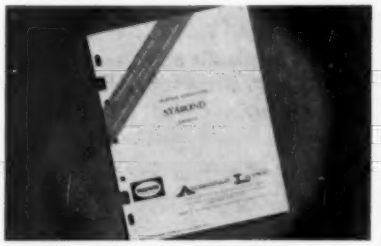
Airliner footrests exposed to roughest wear hold fast when fabricated with new Stabond C-143. Ideal for rubber-to-aluminum seals, this new modified Hycar base adhesive bonds rigid or low plasticized vinyls, natural and synthetic rubbers to themselves or to nonporous metal surfaces.

Metal Bond Withstands 500° Temperatures

Stabond EP-115 two-component epoxy base adhesive recently developed by American Latex has produced metal-to-metal bonds resistant to temperatures in the range of 450° to 500° F.

The new material is also suitable for casting purposes such as tooling, dies, match plates, prototype molds, etc.

This highly filled compound, after cure, can be machined, sanded, filed, drilled and tapped similar to a light metal alloy.



Tech Data Available

Formulations and specifications of standard Stabond adhesives developed by Freedlander Research and Development Laboratories is available in a technical information bulletin.

Organized as to principal use, type, color, coverage, shelf life, temperature limits, consistency, tack period, flammability, toxicity, etc., the bulletin is a handy reference for every adhesive user.

Copies will be sent to interested parties upon request. Contact Freedlander Laboratories or your nearest American Latex branch office.

EP-110 Cuts Fabricating Costs

Efficient and time-saving bonding methods in the fabrication of metals, glass, wood, thermosetting plastics, hard or vulcanized rubber, are made possible by Stabond EP-110, new two component adhesive developed by American Latex. Unique mixing system makes EP-110 easier to use than traditional two-component bonding agents; eliminates measuring, weighing, waste. Stabond EP-110 will cure at room temperatures or can be oven heated for rapid setting.

Freedlander Lab Develops 28 New Adhesives

Current product list of the Adhesives Division of American Latex Products Corp. numbers in excess of 150.

Freedlander Research and Development Laboratory, American Latex R & D facility, successfully developed 28 new adhesive products during 1959.

More than 480 adhesive formulations have been perfected in the Freedlander Adhesive Laboratory, providing a substantial backlog of technical understanding. Adhesive Laboratory personnel at American Latex have a total experience of over 65 years, a rare background in the young adhesive industry.

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ADHESIVES AGE

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About the Cover Photograph

The cover photograph for this month's issue of ADHESIVES AGE is a reflection of the national excitement as voters all over the country prepare to go to the polls. It shows some of the candidates available for tough assignments in industrial chemical fastening. Take your pick. The selection is perhaps simplified in that here, at least, it's performance only that counts.

The opinions expressed by authors and contributors to ADHESIVES AGE are not necessarily those of the editors or publisher. Articles appearing in ADHESIVES AGE may not be reproduced in whole or in part without the express permission of the publisher.

PALMERTON PUBLISHING CO., INC.

NOVEMBER, 1960
VOL. 3, NO. 11

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Indexed in Industrial Arts Index and Engineering Index.

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10,600 Copies of This Issue Printed

ADHESIVES AGE is published monthly by the Palmerton Publishing Co., Inc. Printing Office, Bristol, Conn. Editorial and Advertising Office at 101 West 31st Street, New York 1, N.Y. Subscription in the United States, $5.00 a year; Canada, $5.50; Foreign, $6.00; Single Copy, 50¢. November, 1960. Volume 3, Number 11.

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Published Monthly by
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Editorial and Advertising Offices
101 West 31st St., New York 1, N. Y.
Phone: PEnnsylvania 6-6872

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EDITORIAL

Organization and Coordination

There are now twenty separate and distinct organizations serving the adhesives industry in one way or another. A few months ago, when we editorially addressed ourselves to this matter, we counted fourteen groups. By this time next year, there may be twenty-five, perhaps more. Many of the twenty organizations devote themselves to a specific matter; one is concerned with wood glues; another with epoxy formulations; a third concerns itself with paper adhesives; a fourth is involved with particle board, and so on.

We accept the premise that each of the organizations was formed to meet a specific need. We accept the premise that each of the organizations involved is doing a good job. We are pleased that the adhesives industry has grown to a point where twenty organizations have been formed. We are delighted that people have found it advisable to give their time and their efforts to serve on the various groups. We are stimulated by the over-all interest in the industry. We are gratified at the results many of the groups have accomplished. We are happy to participate in the activities of many of the committees.

BUT

Are we spreading ourselves a bit too thin? Are our specific and immediate interests obscuring a bigger picture? Is the time fast approaching for a unity of purpose? Shouldn't there be a "cohesiveness" to our efforts? Is there a need for an over-all group which will encompass, through sub-groups, most of the matters currently of note in the adhesives industry? Are some of us working at cross-purposes?

If the answer to any of the questions is "yes", we would respectfully submit that some liaison be established between the different groups. Liaison aimed at establishing a community of interests. Liaison aimed toward a multilateral approach to the solution of mutual problems. Liaison directed to the idea that adhesives people, be they manufacturers or consumers, have many matters which can best be served by common effort.

It is, of course, entirely possible that there is a distinct need for twenty or thirty different organizations. Perhaps this is the proper way to do the job. In the light of the experience of other industries we would be inclined to doubt this assertion. We are inclined to the belief that many of our problems will not be solved by going off into different directions.

We ask for some thought on this matter. We offer to officers and members of the various groups, as well as to any interested party, a complete listing of the twenty adhesives groups known to us. Drop us a note asking for the adhesives organization listing and we will be happy to send one along. Address the Managing Editor, ADHESIVES AGE, 101 West 31st St., New York 1, N. Y.

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CONSULTANT'S CORNER

By Dr. Irving Skeist

Emulsion Paint

Question: I am considering painting my seven-year-old, brick (not very good grade) house with a top grade acrylic emulsion masonry paint. However, a number of painted brick houses I see show extensive peel.

Is there a bonding coat that can be applied to the bricks prior to painting, or is there a clear solvent lacquer that can be applied on top of the emulsion coating to prevent moisture from attacking the water soluble emulsifying agents in the paint film?

Answer: It is desirable to apply an oil-base primer before using emulsion paint on a surface for the first time. Your paint dealer can advise you. The primer is not a lacquer, but is similar in composition to conventional oil paints. Once you have your coat of emulsion paint down, you can repaint without priming.

Q-172

Hardboard

Question: We are seeking a fast setting contact cement to fasten hardboard garage door ornaments to either hardboard or plywood garage door panels. The adhesive must set up fast, must be waterproof and must not be affected by temperature and climatic changes. Will you please advise the best material for this application?

Answer: If your operation is to be performed in the factory, you may wish to try resorcinol-formaldehyde adhesives. These are capable of setting at room temperature, but can be speeded with a hot iron or strip heaters. With ultra-high-frequency, setting takes place in seconds.

On the job, a neoprene solvent cement may be the most satisfactory. Apply to both surfaces and air-dry two to five minutes before mating the parts.

Q-169

Dr. Skeist is associated with Skeist & Schwarz Laboratories, Inc., 89 Lincoln Park, Newark 2, N.J. He is the author of the recently published book, "Epoxy Resins."

Still More on Teflon

The following are excerpts from a letter received from R. S. Mallouk, Film Dept., E. I. du Pont de Nemours & Co., Inc.

"Recently, the du Pont Company developed a new technique for rendering the surface of Teflon FEP film cementable with common adhesives. We are currently offering this modified Teflon FEP film on a sales development basis and looking towards commercial operation in 1961.

"Our new cementable film can be bonded, using epoxies and rubber-based adhesives, to a host of substrates including metals, wood, polyethylene, various fabrics and glass.

"In addition to this modified film for use with adhesives, our standard line of Teflon FEP film is heat-bondable to metallic substrates and inorganic fabrics, such as glass or asbestos, which are capable of withstanding high melt temperatures. The operation consists of pressing the film and substrate together at temperatures exceeding 550°F. In other words, in many cases our standard line of unmodified film may be used as an adhesive layer to bond metals, glass, fabric and other high temperature substrates.

"Composites prepared by either the adhesive laminating technique or the heat laminating technique, can be post-formed into complex shapes without delamination."

Operating Temperature of 1000°F.

Question: We require a material to patch small pinholes in 200 x 1400 stainless steel wire cloth. This mesh is a double Dutch weave and occasionally, in the process of manufacture, a strand will break and a series of pinholes are formed. The operating temperature for this filter medium is 1000°F. The gas to be filtered is air.

Is there, to your knowledge, any plastic patching material which could stand up under the above conditions? In the past, under much lower temperature conditions, we have used a clear epoxy adhesive for this purpose. The results were very satisfactory.

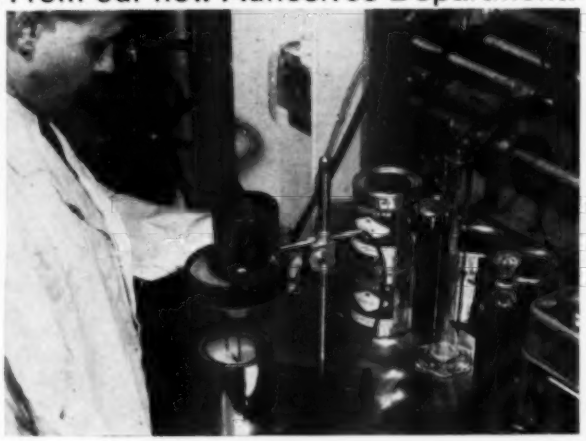
Answer: Progress is being made on organic/inorganic hybrid adhesives which will stand up to 1000°F., but none has proved itself yet.

Among completely organic adhesives, the most heat resistant is probably a variation of the formulations developed by the U.S. Forest Products Laboratory—blends of phenolic and epoxy, applied from solution and heat-cured. Novolac type (polyfunctional) epoxies are now available which provide improved heat resistance. If the exposure time is short, a phenolic/epoxy might do. But no organic material now available is suitable for prolonged exposure to 1000°F.

Q-163

Readers who would like to contribute their own experience with problems similar to those discussed in Dr. Skeist's column are invited to write to ADHESIVES AGE, *101 West 31st Street, New York 1, New York. Please refer to the code number given at the end of each question and answer group.*

From our new Adhesives Department:



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New and yet not new. That's our Adhesives Department. For although newly formed to give you better service in the increasingly important field of chemical fasteners, it's founded upon well over a half-century of experience in developing and manufacturing tailor-made adhesives for a wide range of uses.

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PLIOGRIP 12-7. Developed as a binder of ferric oxide to computer tape. Exhibits high bond strength and excellent flexibility, dries rapidly.

PLIOGRIP 22-4. Designed as a plastisol-to-metal primer in pipe joints. Activates at 350° F. Provides outstanding adhesion.

PLIOGRIP 13-5. Developed to bond chloroprene rubber to nylon sheet or fabric in industrial belt stocks. Reported peel strengths range up to 70 psi.

PLIOGRIP 12-1. Designed as sealant for aluminum and other metallic joints. Displays high strength, lasting flexibility, excellent weather-resistance.

Perhaps one of these new adhesives—or one still under development—can solve your adhesion problem. Why not see your local Goodyear Adhesives Distributor for more information and samples. Or write Goodyear, Chemical Division, Dept. W-9466, Akron 16, Ohio.

GOODYEAR
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new adhesives

AND ADHESIVE PRODUCTS

Flame-Retardant Laminate

Insurok T-777, a new grade of Flame-Retardant Laminated Insurok, is a paper-base, phenolic laminate described by its manufacturer as having exceptional flame-retardant

characteristics. It is available in copper-clad or non-clad form. It meets NEMA XXXP requirements and is said to have all the flame retardance required by presently-known specifications. T-777 possesses good electrical properties, fine dimensional stability and superior punching qualities, its manufacturer reports. It is classified as a hot-punching grade and requires moderate heating, and its manufacturer suggests its use particularly for the radio, TV, electrical and electronic components market. The product is available in all standard sheet sizes, thicknesses and tolerances. *Richardson Co.* **P-392**

Fluorocarbon Modifier

Bondaid is a stabilized dispersion of metallic sodium designed to modify the surface of flourocarbon polymers to make them receptive to an adhesive so that bonding is possible. It treats the fluorocarbon so that a carbonaceous film is created, which serves as an anchor for any applicable adhesive: resinous, elastomeric, epoxy, casein or ordinary household type. According to the manufacturer, through the use of Bondaid any fluorocarbon can be bonded to metals, plastics, glass, ceramics, textiles, wood, rubber, etc. The product is said to have a high flash point, low vapor pressure, and low surface tension, and to be adaptable to spot, batch, or continuous operations. *W. S. Shamban Co.* **P-393**

Polyvinyl Acetate Adhesives

Four new polyvinyl acetate wood adhesives for building, furniture, and assembly applications have been introduced under the Cascorez trade name. The products are designed specifically for assembly of pre-fabricated cabinets, built-in furniture units, stair units, general and on-site millwork, custom panelling and partitions, pre-fabricated closet and door assemblies in the building field.

Cascorez CV-735 is a high-tack, high joint strength emulsion for modern gluing operations where unusual wet tack is essential. Cascorez CV-731 is a medium solids, low cost adhesive designed for applications where medium joint strength is sufficient and cost is of primary concern, according to the manufacturer. Cascorez CV-728 is a medium solids polyvinyl acetate emulsion, featuring moderate cost and fast setting speed. Cascorez CV-737 is said to be a fast setting, very high joint strength adhesive, which possesses excellent storage stability. *Borden Chemical Co.* **P-394**

Resin-Type Adhesive

Unusual thermoplastic-thermosetting properties, particularly effective for adhering plastics, metals, glass and various rigid, non-porous materials, are claimed for Bostik synthetic resin-type adhesive 7008 by its manufacturer. Particularly recommended by its maker for manufacturers of speaker coils, laminated circuits, multiple contact assemblies, and other components in which phenolic-impregnated fabric or electrical board must be adhered to metal, the adhesive is said to be quick drying and, when cured, to have good heat resistance. It will bond effectively at room temperature, but a thermosetting reaction, occuring at 250° F. or above, provides maximum film strength. At 300° F. to 350° F., curing is accomplished within 18 minutes. The adhesive has a solids content of about 28 per cent, is amber in color, stable for at least six months in closed containers and is odorless. *B. B. Chemical Co.* **P-395**

Water-Soluble Dextrins

A series of cold-water-soluble dextrins marketed under the brand name Koldex are said to offer more uniform and stable viscosity, light color, versatility, and ease in preparation, for a variety of adhesives applications. Koldex 20, 30 and 40 are three borated dextrins designed to produce liquid adhesives in the 1,000 to 1,500 centipoise viscosity range measured at 80° F. with solids concentrations of 20, 30 and 40 per cent. The new dextrins are made by formulating regular specification

dextrins with borax, preservatives and defoamers into a prepared liquid adhesive which is then spray dried. Koldex dextrins are packed in 50-pound, polyethylene-lined, multiwall paper bags, and may be readied for use by merely adding to water, then agitating, an hour before application. *A. E. Staley Mfg. Co.* **P-396**

Versatile Bonding Cement

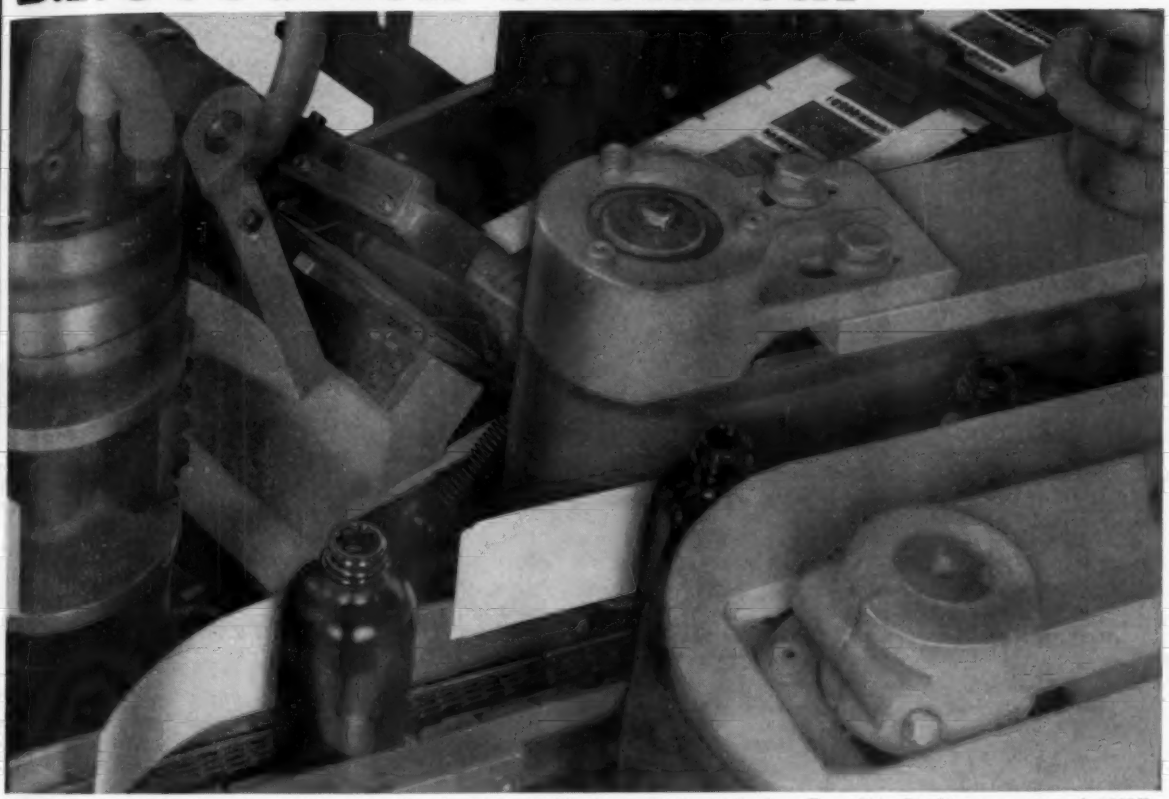
Proxseal Adhesive No. 37-164-8 can be used as either a wet bonding cement, or applied to the individual surface, dried and subsequently solvent-activated to accomplish the seal. It can, according to its maker, be used with equal success on similar or mixed surfaces, including vinyl, Saran, Pliofilm, rubber, polymer coated cellophane, and glass, as well as a variety of metals. *Pyroxylin Products, Inc.* **P-397**

High Peel Adhesive

Hysol 10-001 is reported to offer peel strength of 63.3 inch/lbs. on aluminum-to-aluminum, as well as tensile shear strength of 3,000 psi, a three to four day pot life, and 45 per cent elongation. Its manufacturer recommends it for use in bonding aluminum honeycomb panels, ferrous metals, ceramics, and glass. *Hysol Corp.* **P-398**

Another new development using

B.F.Goodrich Chemical *raw materials*



Heat Seal label stock like that being used here is made using Hycar by The Brown-Bridge Mills, Inc., Troy, Ohio. Blocking temperature is 135°F., activation temperature, 190°F., with sealing range from 275 to 375°. B.F.Goodrich Chemical Company supplies the Hycar nitrile rubber.

High speed label stock gets adhesive strength from Hycar

This paper for high speed production labeling is coated with an adhesive made with specially-compounded Hycar polyacrylic latex. It is designed for delayed action use on machines labeling bottles of drugs, cosmetics and other liquids. It is also used on a wide variety of other surfaces after being heated and then pressure-applied.

Hycar produces adhesives entirely different from those made with natural rubber—curing to form high strength bonds on many types of material where other adhesives will not produce desired long-lasting bonds. For example, this paper manufacturer recommends its use for such broadly diversified materials as metal foil, hard rubber, wood and some textiles.

Hycar also gives improved shelf life in cements, simplifying inventory problems, and good color in dried films. Specific information on many uses of Hycar nitrile rubber in adhesives is available. For more facts, write Dept. FF-4, B.F.Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

Hycar
Reg. U. S. Pat. Office
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Labeling Materials

A self-adhesive labeling material developed especially for use on food packages kept under refrigeration, which need only be pressed into place, and requires no moistening or

package preparation, has been introduced. It is said to adhere to all types of cellophane, polystyrene, Saran, and other common packaging films, and has, the manufacturer states, been tested at temperatures of −20° F. The material comes in rolls and can be die cut to any shape or size desired. It can be printed in any color, and can be supplied in satin or high gloss white, as well as orange-red, orange-yellow and chartreuse. *Fasson Products.* **P-399**

Glued Lap Adhesive

A new type of glued lap adhesive designed to speed production and lower costs in the box-board industry, #1593 Glued Lap Adhesive is said to incorporate the desirable features of more expensive synthetic resin adhesives, but to be more economical. Capable of withstanding temperature extremes of from 370°F. to −70° F., it is said to provide a fast setting bond, as well as good open time so that it can be re-sealed if the bond is disturbed during production. The bond is said to withstand humidity, moisture and rough handling without weakening or breaking loose. Tensile shear tests showed that the product yielded 100 per cent fiber tear. *H. B. Fuller Co.* **P-400**

Versatile Bonding Agent

Magic Epoxy Glue is said by its manufacturer to form a hard, permanent bond, stronger than materials themselves. It is waterproof, transparent, and said to attach the following materials to themselves and to each other: steel, aluminum, brass, copper, iron, glass, wood, pottery, porcelain, leather, masonry, plastics, and china. *Magic Iron Cement Co., Inc.* **P-401**

Non-Corrosive Teflon Tape

Temp-R-Tape TSP is a pressure-sensitive Teflon tape for extreme high-temperature design. The non-corrosive tape utilizes a silicone polymer adhesive and a skived Teflon film backing to which a special primed surface is applied. Two advantages are stressed by the manufacturer: it will accept encapsulating resins and electrical varnishes, it can be marked with almost any commercially available ink. The tape's maker recommends it for electrical applications where high dielectric strength, low power factor and negligible moisture absorption is important. High elongation provides a tight wrap over sharp bends and compound surfaces, and a plastic memory increases this fit. *Connecticut Hard Rubber Co.* **P-402**

Thermosetting Topping

A new thermosetting plastic floor topping, Zelonide, is said to offer adhesive qualities and toughness which resist most acids, alkalis, oils, greases and detergents, as well as thermal shock and moisture. It is suggested by the manufacturer for use in bottling plants, dairies, meat packing plants, canneries, breweries, laundries, chemical plants and laboratories. Chemical and abrasion resistant, the floor topping withstands wet heat up to 212° F., it is said, and bonds firmly and completely to concrete, metal and wood. The manufacturer recommends its use where a thin but tough floor topping is needed and where corrosive conditions exist. Zelonide is said to possess four times the tensile and compressive strength of concrete, and ten times its flexibility. *Monroe Co.* **P-403**

Coating Resin

A newly available water-system, latex form of polyvinylidene chloride resin, designated as Resyn 3600, can be applied to a variety of porous and non-porous substrates by standard coating equipment. It is said to impart outstanding barrier and protective properties among which are extreme resistance to transmission of water vapor and common gases such as oxygen, nitrogen and carbon dioxide. Other features include chemical inertness and non-flammability. The coating is unaffected by grease and common automotive lubrication oils. Suggested applications include use as a non-woven binder for industrial applications. *National Starch and Chemical Corp.* **P-404**

Strapping Tape

A new Bear strapping tape, said to possess both high adhesion and a 12 per cent stretch at break, is recommended by its maker for industrial use where prevention of damage

to materials due to shock or poor packaging is of prime importance. It is suggested for bundling of pipes, tubes, and lumber, for instance, and is said to supply extra-firm reinforcement to cartons through its ability to flex easily to contours of packages. Made with a vinyl backing and reinforced with rayon filaments to furnish bi-directional strength, the tape is also pressure-sensitive, and has a tensile strength of 240 lbs. per inch of width. *Behr-Manning Co.* **P-405**

Pressure-Sensitive Foam

Both the pressure-sensitive adhesive and the polyurethane foam used in RPM Fire Retardant tape conform to Military Specification M-R-00200-92C (Ships). In accordance with the test described therein, when a red hot bolt is allowed to burn a hole through a ¼" thick pad of foam adhered to metal, the flame is extinguished within seconds after the bolt is removed. The self-extinguishing material is used for cushioning, insulating, gasketing and as a light vapor and dust barrier. *Richards, Parents and Murray, Inc.* **P-406**

Creped Paper Tape

A glass-reinforced creped paper adhesive tape, known as C-470 Strapping Tape, has been introduced to serve a variety of packaging and bundling purposes where extra strength is required. It is a moisture-resistant paper tape reinforced with 45 continuous glass filaments per inch of width, and its rubber-based adhesive is pressure-sensitive with adhesion to back of 70 pounds per square inch. It has a tensile strength of 240 pounds per inch width. *Arno Adhesive Tapes, Inc.* **P-407**

SILICONE NEWS from Dow Corning

New Process Aid

Silicone Coated Papers Speed Processing of Sticky Products

When processing sticky materials and products, such as raw rubber, candy or resin-bonded laminates, "stickers" can cause lost time and extra cost. They can, but don't . . . if you specify interleaving or process papers with the new Syl-off® silicone stickproof coatings. Syl-off coated papers give quick, easy and complete removal of sticky products, help keep production moving smoothly, hold product waste to a minimum.

AIDS PACKAGING, TOO. Syl-off coated paper and paperboard are now used in packaging a variety of sticky products . . . from asphalt to sweet rolls, from adhesive masses to candied fruits. Standard containers available with Syl-off coated liners or inner surfaces include multiwall bags, fiber drums, unit containers, cores and cartons. Pan liners and wrappers coated with food grade Syl-off may be used in contact with food in compliance with the provisions of the Food Additives Amendment of 1958.

MORE ADVANTAGES. Syl-off coatings have natural nonoily lubricity and water repellency . . . won't migrate, contaminate or transfer . . . won't alter the characteristics of paper stock. Whether you process, ship or receive sticky materials, Syl-off coated papers are worth looking into. For the complete list of Approved Sources, plus a descriptive brochure, write Dow Corning, Dept. 0111.

For complete technical information about any silicone product, contact the Dow Corning office nearest you.

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MIDLAND, MICHIGAN

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capitol cues

NO BIG ANTI-RECESSION PROGRAMS ARE BEING PLANNED now in Washington. The official line from the President on down is that business will stay good throughout the year. Until the contrary is crystal clear, officials will not even consider new programs for more spending. They fear budget deficits and renewed inflation. Besides, many feel the new President should make his own plans next year. For the time being, reliance is placed on easing of money.

> Treasury Secretary Anderson has summed up official thinking on business prospects: Having gone through an inventory shake-out, the economy is now cleared for growth. He sees no slide this year or during 1961. However, it is worth noting that this view is being vigorously disputed by many economists.
>
> A big group of economists is more impressed by the number of key indicators that are either standing still or heading down. This sluggishness, they feel, is a certain prelude to a slide either late this year or early in 1961. The pessimists don't see anything--such as a plant and equipment boom or increasing auto sales--coming along to push the economy off dead-center.
>
> Here are some of the declining indicators which they cite:
> -Capital spending topped out last quarter and now is dropping.
> -Inventory building is over and there may be some liquidation.
> -New orders have already begun to decline and are below 1959.
> -Industrial output, after months of stability, is declining.
> -Retail sales confounded expectations by falling last Summer.
> -Employment is leveling off and unemployment is on the rise.
> -Corporate profits won't even match those of strike-hit 1959.
> Admittedly, the declines have not been very great to date.

A BLUEPRINT FOR FIGHTING A DOWNTURN is quietly being drafted by some economic advisers for the Democratic Party. They, too, see no signs of the upturn forecast by Secretary Anderson and other officials. They feel that the next Administration should give top priority to such programs as federal aid for schools, help for depressed areas, slum clearance, higher unemployment benefits, and easier credit. And they don't rule out a tax cut for those in the lower brackets, though this would be held in reserve. They would let the federal budget run a deficit until they could be sure business is recovering.

CONSUMERS PLAN TO BUY FEWER DURABLE GOODS within the next six months, as compared with last Fall, according to a new government survey of 17,000 households. Only 3.0% of those surveyed plan to buy a new car; last October, the figure was 4.6%. Those expecting to purchase a used car within the next six months declined from 4.6% to 3.7%. Buying plans for appliances--TV sets, washing machines, and refrigerators--have decreased, too. These purchasing plans mean that merchants may have trouble this Fall in matching '59 sales.

CORPORATE PROFITS WON'T COME UP TO EXPECTATIONS this year. They're now running behind 1959 and the trend is still down. The main reason for the disappointing showing: the steady increase in costs of labor, supplies, transportation, and many overhead expenses.

BERNHARDT FURNITURE
Eliminates Culled Panels with
RCI
PLYAMINE-BASED ADHESIVE

"Thanks to Reichhold's PLYAMINE Resin, we have completely eliminated the serious and expensive problem of defective, or 'culled' laminated wood panels caused by resin 'bleed-through'": Colon Prestwood, Plant Superintendent, Bernhardt Furniture Company, Lenoir, N. C.

At Bernhardt, as well as at many other laminating plants, Reichhold's PLYAMINE resins have proved themselves superior for high-strength, rigid bonding applications.

The forest and furniture industries have learned to depend on Reichhold for *fast delivery* of a full line of urea-formaldehyde, phenol-formaldehyde, polyvinyl acetate and resorcinol adhesives and protein glues.

RESIN BLEED-THROUGH NO LONGER A PROBLEM!

Creative Chemistry ... Your Partner in Progress

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Ortho-Phenylphenol • Sodium Sulfite • Pentaerythritol • Pentachlorophenol • Sodium Pentachlorophenate • Sulfuric Acid • Methanol

capitol cues (cont'd)

THE BUDGET SURPLUS IS FADING RAPIDLY, say government fiscal officers. The President originally estimated spending for the 12 months ending June 30 at $80 billion and forecast revenues of about $84 billion--thus, a surplus of $4.2 billion. But, now, those early estimates appear to be too optimistic.

Here is the way the federal budget picture now shapes up:
-Spending will be up $600 million from prior estimates. The reasons? More defense spending, federal pay increases, etc.
-Revenues will be off $2.5 billion, because of lower profits.
Net, there will be a surplus of only about $1.1 billion, if that. The declining surplus dampens hopes for tax reduction.

PROSPECTS FOR AUTO SALES IN 1961 point up the so-so business outlook. Deliveries of both domestic and foreign cars seem likely to total 6 million. That will match the average of recent years but will run 700,000 under '60. And those who buy will go even stronger for small cars--40% instead of 30%. Not until 1962 is there likely to be another new surge in new-car sales.

Prices of 1961's will be about the same for most of the lines produced in this country. However, competitive pressure will be put on domestic makers by reductions in prices for foreign autos. This will produce a big scramble for sales next year.

NEW CHANGES IN THE SOCIAL SECURITY SYSTEM--carried in the law signed recently by the President--will give several big breaks to elderly retirees. Beneficiaries can earn more after retirement without losing their benefits. The old law took away payments from beneficiaries for one month for each $80 (or fraction thereof) that was earned over and above $1,200 in any one year. Now, the loss will be $1 for each $2 of earnings between $1,200 and $1,500. For income over $1,500, individuals will lose amounts equal to the excesses.

Two other important changes were made in the new law.
-Disability payments will begin with the employee's injury. Previously, the benefits couldn't start before the age of 50.
-Work requirements for full benefits now call for coverage in only a third of the quarters for 10 years--not for half.
If you want a fuller explanation, write the Gov't. Printing Office, Washington, D. C., for a copy of the booklet--"The Social Security Amendments of 1960". Cost is 5¢ per copy.

FOUR NEW GOVERNMENT PUBLICATIONS have just been issued which may be of interest to you. They cost little or nothing from various U.S. agencies.

-"Guides for Profit Planning" tells how to figure break-even points, gross margins, and rates of return on investment. It costs 25¢ from Gov't. Printing Office, Wash., 25, D. C.
-"The Power to Produce," the 1960 Agriculture Yearbook, tells about farm mechanization. It costs $2.25 from Government Printing Office. Your Congressman has some free copies.
-Eliminating price markdowns is discussed in Marketers' Aid 57, put out by Small Business Adm., Wash., D. C. It's free.
-Tax deductions from hurricane losses are detailed in a new Internal Revenue Service pamphlet. It's free from your IRS office. Ask for "Tax Treatment on Losses from Hurricanes."

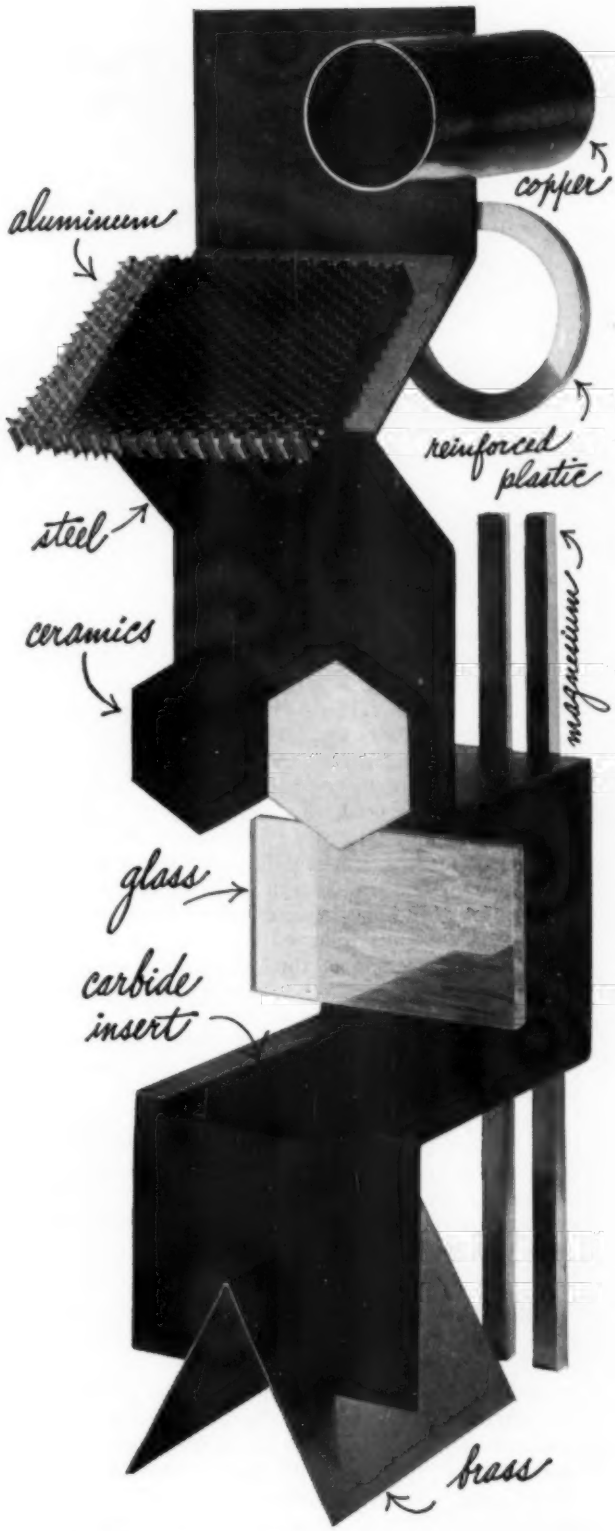
WHAT DO YOU WANT TO BOND TO WHAT?

Take a structural material—for instance, any of the materials shown to the right. Want to join it to itself or another material? Then chances are that SCOTCH-WELD® Brand Structural Adhesives are your best fabricating answer. This modern high strength method of joining materials permits improved design and production techniques . . . cuts costs . . . offers unique benefits.

For example: Smoother contours result when mechanical fasteners are eliminated. Fabricating complex shapes—often impossible or too expensive with ordinary fastenings—is made easy and economical with SCOTCH-WELD Adhesives. In fact, costly complex castings can often be replaced by two or more inexpensive simple castings bonded together with SCOTCH-WELD Adhesives. And lighter gage materials may be used where desired, since stress is spread over a wide area. Often, too, inspection and production steps can be eliminated. Another benefit—unusual combinations of materials which can be joined in no other way can be bonded perfectly with SCOTCH-WELD Adhesives.

Throughout the metalworking industry, bonding with SCOTCH-WELD Brand Structural Adhesives is improving quality, speeding production and cutting costs.

SCOTCH-WELD Adhesives may be the answer to your design and production problems . . . and improve your product at the same time. For full information write on your company letterhead, outlining area of interest, to: AC&S Division, 3M Company, Dept. SPY-110, St. Paul 6, Minn. "SCOTCH-WELD" is a Reg. T.M. of 3M Co.



ADHESIVES, COATINGS AND SEALERS DIVISION

MINNESOTA MINING AND MANUFACTURING COMPANY

. . . WHERE RESEARCH IS THE KEY TO TOMORROW

3M COMPANY

Production of Non-Skid Flooring. Non-skid flooring prevents many accidents which usually result from slippery floor surfaces. At present epoxy resins can be processed into non-skid flooring suitable for use in such locations as stairs, steps, ramps, loading bays and even road surfaces. Epoxy resins, when cured, have good chemical resistance, are resistant to abrasion (particularly when used with appropriate fillers) and have good adhesion to many types of surface. Two methods of making non-skid flooring have been developed—the first utilizing a heavily filled resin-hardener mix, and the other entailing application of a resin-hardener mix followed by an aggregate filler.

In the first technique, the components are thoroughly mixed in a specified order and the composition trowelled on to the surface, which can be either concrete, metal or wood. In the latter method, the component parts of the mix (except the aggregate) are thoroughly mixed and the coating applied to the surface to be treated. The aggregate filler is scattered over the coating until it is completely covered and the composition consolidated by rolling. The coating is allowed to harden (24-28 hours at normal ambient temperatures) and any excess of aggregate is swept away from the surface.

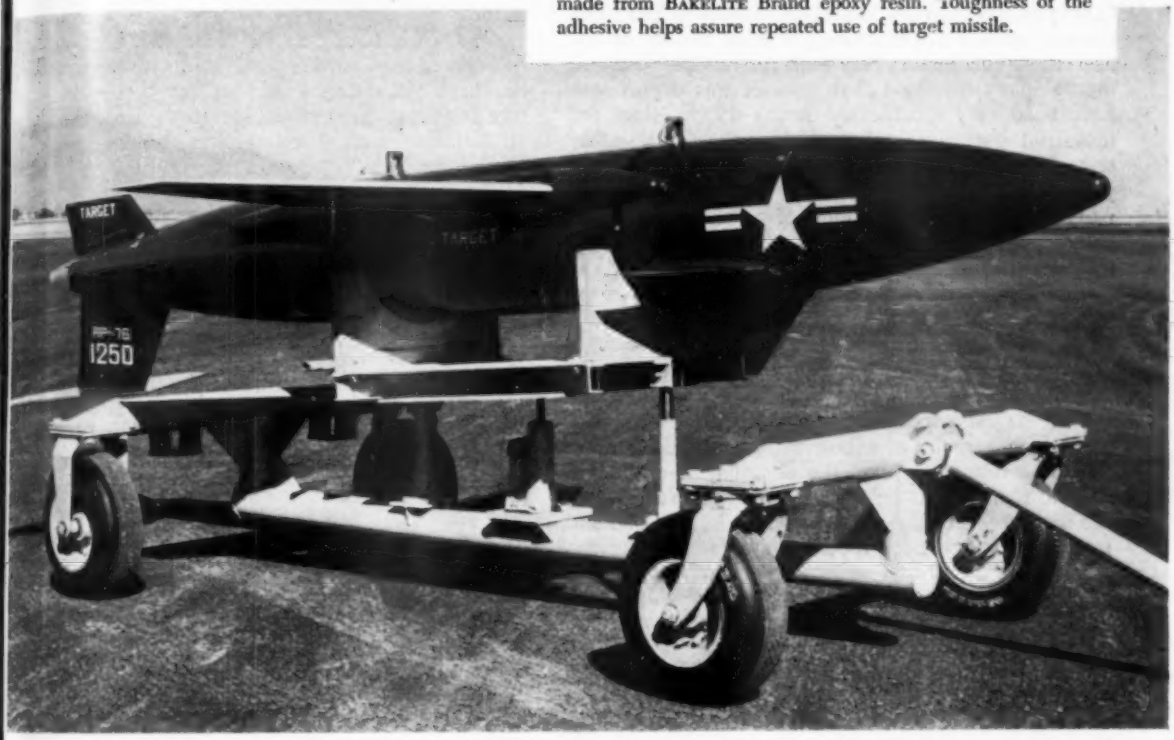
Other Uses for Epoxy Resins. Epoxy resin adhesives are used as an alternative method of joining materials together in the electrical industry. Cast epoxy resin insulation is not only an improved alternative, but, furthermore, has led to the introduction of new concepts of design. Casting of epoxy resins is normally carried out by simple gravity techniques; the epoxy resin-hardener mixture in a liquid state is poured into molds of metal, or plastic, or other suitable materia', and cured.

Although the term "casting" is used to describe the general process, it usually implies the production of a component where the mechanical, as well as the electrical insulation properties are prominent. Potting, or encapsulation implies the complete embedment of an electrical component in a protective mass of resin, which not only insulates but also protects the article against vibration, shock, chemical attack. It prevents ingress of dust and moisture, etc. Simple techniques, inexpensive tools and molds enable insulators, supports and composite structures to be made quickly and accurately with substantial reductions in weight, size and cost and with elegant simplification of design. The use of adhesives in the construction of electrical machinery is also described in a comprehensive article published in the East German trade paper *Plaste Und Kautschuk* in its July issue. Based upon this article it is clear that the technique is still in its infancy and far from the accomplishments which have been developed in the United States and other parts of the world. Included are descriptions of simple bonding techniques for joining very small parts which heretofore have been fastened to each other by means of screws or rivets. It seems that standardized adhesives called Epilox EGK 19 and a hardener No. 5 are used and 25 per cent talc added to the mixture.

How to Organize Your Export Business. More and more American companies are taking advantage of the excellent possibilities that exist today to increase their sales to foreign countries. A good inside view of how one of the large organizations went about it was revealed recently by Friden, Inc. The company states that with foreign business accounting for some 25 per cent of total equipment sales, it has followed up growing sales of its products in Western Europe by establishing a new subsidiary company with headquarters in Switzerland. Known as Friden International, S.A., it is located in Fribourg, began operations on September 1, and will have jurisdiction over all the company's equipment sales in Europe, Africa and the Middle East. European markets will account for 50 per cent of Friden's output within a decade—that is the optimistic forecast for the future made by the vice-president of the organization who recently returned from a European tour in connection with the founding of the subsidiary. Sales of Friden's Holland plant have shown spectacular jumps since it was started in 1954. Figures for 1959 showed an increase of 44 per cent over the previous year with the first seven months of 1960 continuing the trend by reaching a 77 per cent increase over the same period for 1959.

Direct factory branches have been located in Johannesburg, Vienna and the Netherlands to supplement a distributor organization which blankets the area. The Swiss locale was decided on only after an exhaustive survey which included Luxemburg, Lichtenstein, Puerto Rico and the Bahamas. All of them offered favorable tax advantages, but, in addition, Switzerland provided a highly central location. Formation of the Swiss subsidiary will enable Friden, Inc., not only to better serve the expanding European market, but also to accumulate needed "plow-back" capital to keep pace with what we consider a rapidly expanding market.

Rocket-powered target missile is nine feet eight inches long with a five-foot wing span. Built by Radioplane Division of Northrop Corporation, the wings and tail have a skin of aluminum foil, bonded to a plastic honeycomb frame with adhesive made from BAKELITE Brand epoxy resin. Toughness of the adhesive helps assure repeated use of target missile.



Even at speeds of 690 miles an hour...

EPOXY ADHESIVE KEEPS TARGET MISSILE'S "SKIN" INTACT

Keeping the aluminum foil "skin" mirror-smooth against the understructure of the wings and tail of this missile was no small problem. Yet an adhesive, produced by Hastings Plastics, Inc., based on BAKELITE Brand epoxy resins and BAKELITE "Microballoon*" spheres did the job. "Microballoon" spheres for increased viscosity and decreased weight, epoxy resin for strength!

Air-launched from a fighter aircraft, the radio-controlled target accelerates to a speed of Mach .94, almost the speed of sound. A Nike missile zooms past, inches from the target drone. A hit, since the target represents an enemy craft, larger than itself. A command signal from the ground, parachute opens, the drone descends, dropping 20 feet per second at ground impact. Now it can be prepared for *another* flight, its aluminum "skin" still intact, with the help of BAKELITE Brand epoxy resin.

Epoxy resins have superior adhesive properties, low shrinkage during cure, and will join diverse materials. They have top resistance to moisture, chemicals and solvents. Combined with glass fiber, epoxies make laminates of great strength and resistance to environmental conditions.

A BAKELITE resin may be the ideal solution for your bonding problem. Choose from the widest range of high-quality resins from a single source—epoxies, vinyls, phenolics. For specific information, please write: Union Carbide Plastics Company, Division of Union Carbide Corporation, 270 Park Avenue, New York 17, N. Y. *In Canada:* Union Carbide Canada Limited, Toronto 12.

*Registered trade mark of The Standard Oil Company of Ohio

UNION CARBIDE

UNION CARBIDE—*producer of the greatest variety of adhesive resins*

BAKELITE and UNION CARBIDE are registered trade marks of Union Carbide Corporation.

On The Continent (cont'd)

Henkel & Co., GmbH, Dusseldorf, the leading factory in the soap and detergent market in Germany recently started manufacturing a great variety of adhesives. A new factory was built for this purpose and the company disclosed that sales of this department have been very satisfactory during 1959. Glues for industrial purposes and special applications, adhesives for the woodworking industry, and many other products have shown remarkable progress. The company manufactures all kinds of adhesives and has enlarged its line continuously; consequently the manufacturing facilities had to be expanded. Recently, the largest factory manufacturing potato starch in West Germany was acquired.

During the last five years adhesives have become an important factor in the export business of Henkel & Co., GmbH. Right now adhesives constitute the second largest export volume of the concern. From 1952 to 1955 sales of adhesives have tripled. During the three following years the company had to fight hard to maintain its export volume. However, during the last two years important increases in domestic and export sales have been recorded.

Jagenbergwerke AG, Dusseldorf, Builds. This company is known all over Germany because it has manufactured adhesives since the turn of the century. During the last few years the company has expanded its sales of bonding agents and adhesives and as a consequence it was necessary to build a new facility. The new factory in Linnich went on stream recently and is designed so that it can produce many kinds of adhesives in the most efficient way. The factory contains new laboratories and it can be assumed that the much enlarged research and development departments will play an important part in the future expansion of the product line.

Epoxy Resins for Tooling. It is perhaps in this application that epoxy resins completely outclass competitive materials. The many reasons for their success are low cost of the completed tool (particularly for short runs), negligible shrinkage on curing (*i.e.* accurate tools can be made) and excellent dimensional stability (*i.e.* tools remain accurate).

Additional advantages are the fact that the complete tool is very light in weight and can easily be handled; the resin possesses excellent adhesive properties which is important when inserts or drill bushings, etc., are to be incorporated. Tools can be made hard or resilient, as required by the particular manufacturing process.

The basic technique of making an epoxy tool is to reproduce an existing surface by laying against it a fluid mass of resin, which is then cured to a tough, substantial, infusible solid. Two basic methods are:

(1) Lay the resin up in the form of a laminate—employing fibrous reinforcement. Glass is usually employed, but a recent development is the use of metal fibers in certain unique and specialized applications.

(2) Cast the resin in the form of a filled mixture. In another method, known as the splining technique, the shape of the tool is built up from a template structure and an original model is not required. Practically all forms of tooling for shaping metals and plastics can be made from epoxy resins, as well as many forms of auxiliary fixtures, etc.

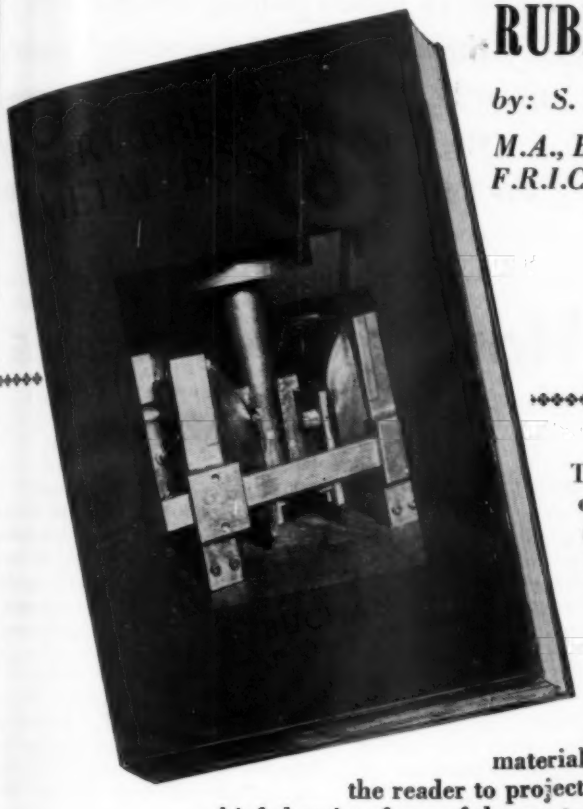
U.S. Mission Promotes Trade. The U.S. Trade Mission to Afghanistan reported to the bureau of Foreign Commerce, U.S. Department of Commerce, that it believes American exporters are not giving the Afghanistan market the attention it deserves. In their 3-weeks' tour of the country, just completed, Mission members found that little effort or attention was being given by American exporters to the existing and potential markets for U.S. goods. Mission member Robert L. Frey of Chicago, Ill. president of Laurence Trading Co., and export-import specialist, reports: "In its present stage of development, Afghanistan offers a small but growing and attractive market for many products of American industry. I am struck by how little effort would be required to increase American sales here, and by how little effort is being made by American firms."

In a typical trade mission, a Department of Commerce official and three or four U.S. businessmen, selected on the basis of the relationship of their specialties to the economy of the country being visited, meet with thousands of local businessmen during its stay in a particular country. Members tour key industrial and commercial centers and usually maintain a trade information center at a trade fair or other specially established location. In businessman-to-businessman discussions, ranging from general meetings and group sessions to individual consultations, members discuss all facets of commercial relations between the two countries—sources of supply, U.S. markets, licensing and investment opportunities, agency-contact inquiries, and others—with their local counterparts. These consultations place team members in a position to discuss the proposal of every American manufacturer with foreign businessmen, so interested persons may communicate directly with the American company.

Twelve Trade Missions will visit foreign countries during 1960-61. Next year Ceylon, Colombia, the Southern Caribbean area, Australia, Japan, Germany, Chile, Uruguay, West Africa and Nigeria will be visited.

Every American manufacturer has an opportunity to have his products discussed with his foreign counterparts free of charge. Write to Trade Missions Division, Bureau of Foreign Commerce, U.S. Department of Commerce, Washington 25, D.C., for additional information. The next Mission will be sent to Ceylon.

NOW AVAILABLE



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This new edition of Dr. Buchan's important and comprehensive work, has been completely revised and up-dated to include the many advances and new developments in the technology of bonding rubber-to-metal in the 10 years since the publication, in 1948, of the widely-acclaimed original edition. Describes processes, applications and methods in detail. Gives concise, straight-forward explanations of how to handle rubber-to-metal bonds at each stage of the job. Sufficient materials are included with each description to permit the reader to project given examples to his own needs. Written by the chief chemist of one of the most successful bonding firms in the world, this is the single most complete source of information about a subject of major technical importance to men working in the rubber adhesive industries.

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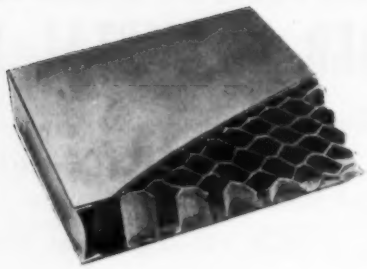


Adhesive bonds joining components of these lightweight sandwich panels must be able to transfer stresses from the facings to the core to profit by the advantages and properties of both

Adhesives For Honeycomb Cores

Adhesives offer several advantages as a joining method for sandwich panels. They act as a barrier film in reducing possible corrosion between core and facings. They act as an energy absorber to help damp out vibrations and reduce the possibility of fatigue. They provide a medium for distributing concentrated stresses more evenly over a wider area. They allow the elimination of external fastenings, so that the finished panel weighs less and has smooth exterior surfaces. Finally, as chemical formulations, adhesives can be tailored to fulfill practically any mechanical or environmental requirement.

Were it not for the comparatively recent and rapid advances in the development and technology of the newer adhesives and fabricating techniques, sandwich construction would certainly not hold the position it enjoys in industry today as a structural material.

It is interesting to note that the actual development of the high-strength, high-stiffness, low-weight sandwich concept with its variety of constructions, closely parallels that of the new high-strength, organic synthetic-resin adhesives. The adhesives, in keeping pace with ever new structural and service requirements as a joining method, have evolved from the recent boom in the plastics and resins field—fostered in turn by its parent, the vast, inventive chemical industry.

The importance of adhesives cannot be overemphasized. They are the absolute *key* to successful bonded sandwich construction. The inherent lack of bonding area provided by the surface of a honeycomb core makes the adhesive bond the critical link in the core-adhesive-facing chain. Nevertheless, properly bonded sandwich structures employing low-density reinforced-plastic or aluminum honeycomb have demonstrated the highest attainable strength-to-weight ratios.

In order for a sandwich panel to perform its function properly, even its weakest component must not fail before the designed load-limit for the sandwich as a whole is reached. The facings carry tensile and compressive stresses and shear flow, while the core sustains shear, compressive and tensile stresses. Cores also provide essentially continuous support of the facings to prevent their premature wrinkling or buckling. Consequently, the adhesive bond joining these components must be adequate to transfer stresses from facings to the core so that the full properties and advantages of both may be realized. Ideally, all components of a structural sandwich would fail simultaneously under load, but this is not usually achieved in practice.

The weight of the adhesive can become a limiting factor in sandwich construction. Because of this, high bonding efficiency or maximum bond strength with minimum adhesive weight is essential if the high strength-to-weight ratio inherent in a honeycomb sandwich is to be realized.

By WARREN D. MYERS

Hexcel Products Inc.
Berkeley, Calif.

The ideal adhesive would, of course, have a bond strength at least equal to the pertinent properties of the materials being adhered. A more realistic and practical goal is that the adhesive should function acceptably throughout the life and environment of its application.

A true, comprehensive definition of an adhesive is difficult. It may popularly be described as a substance which wants to "stick" to something else, or which will adhere two like or unlike materials together. This implies a material that is sticky or tacky in nature and the earliest commercial adhesives were "glues" of animal or vegetable origin which are, indeed, sticky.

The terms "adhesive" and "glue" were considered synonymous until the advent and widescale utilization of synthetic resins. Now, however, adhesive is considered a more inclusive and proper expression, and many of the modern adhesives are not sticky or tacky in application.

A qualified definition of an organic adhesive may therefore be given as: an organic material capable of effecting a substantially permanent union between two or more materials.

What makes one substance stick to another? This is a time-honored, basic question for which there is, unfortunately, no firm single explanation. A comprehensive review of the extensive research work directed toward developing a general theory of adhesion is beyond the scope of this article.

In brief, however, the most widely accepted theories maintain that ad-

hesion can be ascribed to two principal and interrelated actions; one being the attractive forces arising from primary valence or chemical bonds between substances, and the other being electrical or van der Waal's forces arising from residual energies or unequal distribution of charges (dipoles) in compounds having large molecules. These forces of attraction are operative to the extent that molecular nearness between the adhesive and adherend is attained. Thus, the adhesive at some stage in its application or cure must flow and "wet" the adherend to achieve this nearness and form a bond.

Other theories maintain that a third action takes place wherein the adhesive flows into tiny pores of the substrate to produce a mechanical interlocking. However, experimental evidence indicates that mechanical bonds play little if any part in the performance of adhesives.

An increase in bond strength resulting from roughening surfaces is due mainly to the thorough cleaning and possibly to some extent to the increase in surface area produced. Given an adhesive system that has a potentially high strength because of the molecular forces involved and *clean* substrate surfaces, relatively smooth surfaces will usually produce a stronger joint than rough or non-uniform surfaces.

In summary then, it may be said that the cause of adhesion is attributed to the *molecular forces* between the adhesive and adherend. Thus it is assumed that true adhesion is "specific" or chemical and electrical in nature, rather than mechanical.

Adhesives are a large and complex family of substances which are so unlike one another as to require a comprehensive breakdown to obtain a complete picture of their diversity. They may be classified or separated into groups in many different ways and for various reasons; categories range from the relatively simple to the complex.

Classification Types

In addition to being classified by basic resin types and chemical structures (see table), they might be classified in the following ways.

Origin: natural organic and inorganic; synthetic organic and inorganic.

Manner of Gelling: loss of volatile constituent or vehicle; decrease in temperature; release of pressure, activated chemical reaction.

Presence or Absence of Solvent: solvent types (true solutions, emulsions, dispersions); non-solvent types (100 per cent reactive liquids, solids).

Physical State or Available Form: solids—rod, bar, chunk liquids—solvent and non-solvent containing; pastes; foams, powders or granules; unsupported films; supported tapes; pressure-sensitive tapes.

Required Bonding Method: solvent release; vulcanization; catalyzation—room temperature or with heat; heat-setting, heat and pressure setting; reactivation—solvent, heat and pressure.

End Use Requirements: stress resistant; water and humidity resistant; solvent resistant; radiation resistant; sun or ultraviolet resistant; low or high-temperature resistant; dieletric or conductive.

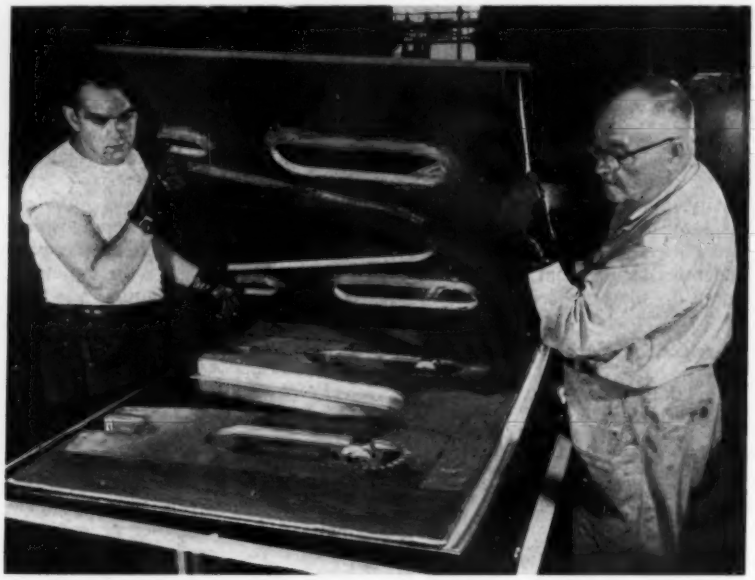
Combination Being Bonded: metal; wood, cork, composition board, etc.; glass, ceramics, tile, porcelain, etc.; plastics (thermosetting and thermoplastic); natural and synthetic rubber, linoleum, asphalt tile; paper film and foil; leather; concrete and plasterboard; textiles.

From the table, it can be seen that no single classification is adequate to completely characterize an adhesive. Nevertheless, one certain classification may be convenient and practical for the production man, another for the designer or engineer, another for the manufacturer and seller, and still another for the adhesives chemist. Most or all of these classifications could be used to give a thorough description of a given adhesive compound.

The majority of synthetic resin adhesives used for structural-type bonding in general and honeycomb sandwich bonding in particular may be conveniently classified initially by their basic resin type and chemical structure. Of course, there would be some exceptions and overlapping in such a compilation due to the tremendous number of possibilities for variation and individual formulations that are offered by present-day adhesive compounding technology.

Newly formulated epoxy adhesive undergoes tests at Hexcel's Berkeley laboratories. Manufacturers of adhesives will provide assistance in solving adhesive problems.

Testing the flexural shear strength of bonded sandwiches is part of quality control.



◀ Final assembly of a honeycomb sandwich. Workers are shown here laying an aluminum skin on the Hexcel core. In a previous operation, the adhesive was applied to a vinyl skin on the aluminum facing.

However, a listing of commercial products based on this more or less fundamental separation would enable a potential fabricator to become familiar with the basic types available.

Obviously there can be no single, all-purpose adhesive which is truly superior to all others. Most adhesives are formulated for a balance of properties with emphasis on certain features. To flatly recommend that a particular basic adhesive type, such as a "thermoset" or a "phenolic," be used for a specific application (for example, joining aluminum honeycomb to porcelain-steel facings) may be very misleading. In fact, it is substantially impossible to recommend even a specific commercial product without knowing all the details of the proposed structure and its intended end use.

Several factors must be given careful consideration in order to select the proper adhesive for a given bonding job. These may be enumerated to help show the necessity for the thorough analysis which should be made when adhesive bonding is contemplated as a joining method.

(1) *Adhesion.* Does the adhesive adhere to the base materials being bonded?

(2) *Service requirements.* Does the adhesive withstand the environmental conditions to which it will be exposed and will it function acceptably during the proposed life of the application?

(3) *Design and joint requirements.* Does the adhesive satisfy the structural or load-bearing requirements and give optimum joint efficiency and configuration? As a corollary to this, a guide often used is the "weakest link" principle: the adhesive need be no stronger than the weaker of the two components being bonded.

(4) *Bonding method.* Can the adhesive be applied and cured by a practical method and does it allow the use of existing or obtainable production equipment? Has the bonding method an adverse effect on either of the base materials as caused by heat, pressure, solvent, etc.?

Requirements and Costs

(5) *Special requirements.* Does the adhesive need to provide any unusual requirements such as clarity, color, insulation, sealing, etc.?

(6) *Cost.* Does the adhesive have a cost advantage when examined in light of the following points? (a) Cost of adhesive, catalysts, solvents, fillers, etc. (b) Amount of adhesive required. (c) Cost of new tools and equipment; modification of old. (d) Cost of labor for preparation, application, finishing, inspection, etc. (e) Bonding method required (cost of heat, forced air, etc.). (f) Estimated waste and rejects. (g) Space and handling requirements.

The selection problem breaks down into this series of considerations and these steps apply regardless of which adhesive type is under consideration. Although there may be more than one specific product which will do a given job well, the "right" or "best" adhesive can seldom be selected in a haphazard fashion or by considering only a single factor.

It goes without saying that the potential user of a commercial adhesive product should, at least in the beginning, explicitly follow the manufacturer's instructions and recommendations. The manufacturer has developed and tested his product and knows its characteristics, advantages, and limitations. The technical literature accompanying a commercial adhesive usually outlines standard information in more or less detail, depending on the proprietary nature of the particular formulation.

First of all, the literature gives the adhesive's trade name and code number, as well as a description of its chemical, physical, and handling properties, and storage limitations. It lists the materials which may be bonded and details their cleaning or preparation. The adhesive's mixing or catalyzing procedures and pot-life are given, as are the solvents or thinners that may be used.

Application methods are recommended and curing procedures given. Suggestions are made as to schedules for assembly times, curing temperatures, times and pressures. Cleanup procedures and handling precautions due to the toxicity potential of the adhesive or by-products are an important part of the litera-

▲ Workmen place a vacuum bag over a honeycomb sandwich preparatory to curing it in the autoclave. Adhesive manufacturers will recommend the best possible curing techniques for use with their products.

ture. Finally, the physical or mechanical properties of the cured bond with various materials and under various test conditions are described.

This information is usually sufficient to give a fabricator a good start on his preliminary evaluations or bonding program, provided of course, that sound commercial practices are followed. These practices relate to carefulness, cleanliness, good housekeeping, adequate tools and equipment, etc. As more and more experience is gained through use, variations and modifications in processing for a particular application may become apparent. These can be determined and incorporated at the discretion of the fabricator.

Technical Assistance

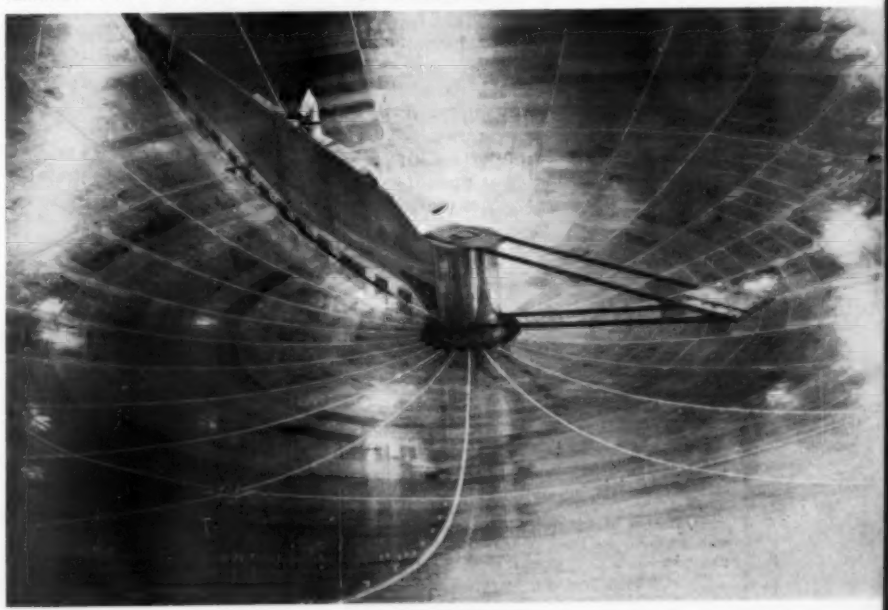
Most manufacturers of adhesives have research and technical service facilities and personnel available to provide assistance in solving adhesive problems. They are usually more than willing to offer these to the user, both in the field and in their own laboratories. Some manufacturers offer detailed questionnaires to be completed and request samples of the items to be bonded whenever there is a possible question regarding the exact nature of the bonding requirements.

A good general rule to follow is: become familiar with the general characteristics of the many types of adhesives, but rely on the manufac-

▲ Removing the honeycomb sandwich part from the autoclave after cure. The above photograph is part of a series made by the Los Angeles Division of North American Aviation, Inc. Aircraft parts with cores include doors, fuselage side panels, etc.

•

▼ The photograph below shows a portion of a new 60-foot radar antenna built by Aeronca Corporation. The reflector and sweep template are made of honeycomb sandwich which meets the unit's extreme rigidity requirements.



turer and his facilities for specific expert advice.

Many structural-type adhesives for bonding metal-to-metal and other rigid or semi-rigid structural materials are often evaluated for comparison and performance by a tensile shear test utilizing specimens having a single overlapped surface-to-surface joint. The performance of an adhesive in this type of joint does not necessarily give an indication of how it will perform in the honeycomb-to-facing joint in sandwich. This is not to say that high-strength lap-joint adhesives will *not* perform well in sandwich. As a matter of fact, many sandwich adhesives have been adapted from formulas originally developed for bonding other joints.

The honeycomb-to-facing joint is actually quite unique. Considering the simplest element—a single cell wall—it can be properly termed a "T" joint because the edge of the cell wall butts against the facing, with the plane of the wall perpendicular to the plane of the facing, to form a "T." A "pure" bonded "T" joint, where the vertical member is thin-walled, is structurally very weak due to the small surface area available for attachment at the extremely narrow interface between the two components. This weakness can be overcome by some manner of mechanical reinforcement.

In a honeycomb-to-facing bond, the reinforcement is provided by the adhesive itself. In addition to bonding the very thin edge of the cell wall to the facing at the interface, the adhesive is applied in sufficient quantity to cover both the facing and a small part of the cell walls. This supports the walls by an embedment effect.

In honeycomb sandwich bonds, the "shape" of the adhesive line or the distribution and configuration of the cured adhesive is important. It has been demonstrated that the formation of a "fillet" of adhesive results in optimum bonding efficiency. An adhesive fillet may be defined as the concentration of the adhesive at the angle between the cell wall and the facing. A fillet, in effect, increases the surface area of the honeycomb available for bonding without a commensurate increase in the total weight of adhesive needed. This results in maximum strength for a given weight of bonding material.

Some adhesives, notably the epoxy or modified-epoxy types, are self-filleting in that during the flow stage in the curing cycle they are capable of moving and wetting to the core to form a natural fillet. With other types of sandwich adhesives it is usually necessary to "build" a fillet by some mechanical means during application. This may be done during "priming" of the core by edge-dipping, brushing, roller-coating or spraying the adhesive so that it concentrates and remains at the bonding or faying surface.

Good resistance to peel stress or "stripping strength" is usually a desirable feature of sandwich adhesives. It helps inhibit the propagation of possible localized failures in the core-to-facing bond. Usually associated with this property in adhesives is flexibility, impact strength, and generally good resistance to abuse and service damage. Good shear strength and creep resistance are also desirable properties for a sandwich adhesive and along with these may usually be found brittleness and good tensile strength.

As a general rule, unfortunately, high values in both peel and shear properties are not usually found in a single compound. That is, superior performance in one area is usually attained at the expense of performance in the other. Formulators of sandwich adhesives usually attempt to achieve a balance in these properties, but may emphasize a certain feature to satisfy end-use requirements.

Recently developed "one-package" supported-tape type adhesives are based on a new principal attempt to overcome the drawbacks of this sort of compromise. They were designed specifically for honeycomb sandwich bonding and are best described as "duplex" tapes. They provide for high strengths both in peel and impact *and* in shear, creep, and tensile. This is accomplished by incorporating an adhesive having good toughness and peel strength on one side of a supporting web and a mobile, self-filleting adhesive having good shear and tensile strengths on the other. In application, the former surface is placed next to the facing while the latter is placed next to the core and the bond is formed under heat and pressure. One commercial product of this type utilizes a phenolic-nitrile adhesive alloy (for the bond to the facing) combined with a modified epoxy adhesive (for the bond to the core).

Adhesives of the same basic resin type or formulations employing resins of the same chemical structure can exhibit widely different properties when used for bonded honeycomb sandwich. Finally, cured strengths are influenced by so many variables that it becomes imperative that each formulation be individually tested and evaluated for its specific merits in a given application.

Classification of Adhesives by Resin Type

Thermoplastic	polyvinyl acetate, polyvinyl acetal, cellulosics, polyvinyl butyral, polyvinyl formal, polyvinyl alcohol, acrylics, polystrene, polyamides and nylon.
Thermosetting	phenolics and modified phenolics, resorcinols, ureas, melamines, furanes, polyesters, polyalkyd, polyurethanes, epoxies and modified epoxies.
Elastomerics	natural rubbers, reclaim rubbers, chlorinated rubbers, polysulfide rubbers, butadiene-styrene, butadiene-acrylonitrole, neoprene or polychloroprene.
Alloys or Resin Blends	phenolic-vinyls: phenolic-polyvinyl acetal, phenolic-polyvinyl butyral, phenolic-polyvinyl formal.
	phenolic-elastomers: phenolic-neoprene, phenolic-nitrile.
	phenolic-nylon, phenolic-neoprene-nylon, "Hycar-vinyl," specific formulas with undisclosed constituents.

About the Author . . .

WARREN D. MYERS joined Hexcel in 1951 as a lab technician and is now senior chemist of the Research and Development Department. He has helped develop many new core materials including a heat resistant phenolic.

Synthetic Glues for Furniture Production

By VIVIAN BIRD

A report from abroad on the trend to using synthetic resin glues in assembly-bonding in order to obtain certain processing advantages

In the woodworking industry, and in particular in furniture factories, assembly-line production methods are finding steadily increasing application. A condition for the introduction of these is, however, that all working conditions be perfectly coordinated.

As long as joiners and cabinetmakers had at their disposal only glutin, blood-albumin and casein glues, gluing work constituted a bottleneck because of the very slow setting times of these glues. Thus it was not until the synthetic resin glues had been developed that gluing operations too could be adapted to meet the requirements of assembly-line production.

Urea-formaldehyde glues were the first to bring relief in this respect and they were soon used in large quantities as "surface glues" for veneering work. The difficulties still encountered in assembly gluing work were, to a large extent, removed through the application of a second group, the PVAc-glues.

Both these groups of synthetic resin glues afford advantages in processing technique over glutin, blood-albumin and casein glues. However, in order to employ them correctly and profitably, it is necessary to know their properties. The strict requirements of users have resulted in a high level of development for these glues which have been "specialized" for use in clearly defined fields of application.

The hardening of urea-formaldehyde glues is due to the completion of the condensation process which had been held in check during their manufacture. In this final stage, molecules of the glue combine to build larger physical units, the so-called macromolecules, whereby formaldehyde is set free. The process is entirely free of a chemical nature and is terminated by the molecules being changed when hardening.

In polyvinyl acetate glues the molecules already exist in the liquid glue in the same state as found in the set film of glue. When setting, these glues give off the water in which the macromolecules are dispersed, as well as any solvents which might be contained therein. At the same time, the cohesive and adhesive forces of the glue become active. Since the setting is caused through exclusively physical processes, it is not correct to use the term "hardening" in connection with PVAc glues. The dry film produced by them remains resilient and thermoplastic, *i.e.*, it softens when exposed to heat. Because of these differences, the properties of these two types of glue in respect to applications techniques and suitability also differ greatly.

Short Hardening Time

Owing to their comparatively low price, their relatively short hardening time with hot press joining, and certain processing advantages natural glues, urea-formaldehyde formulations have come into general use as veneering glues for veneer panels. On the other hand, this glue is not so very well suited for assembly work, for it sets hard and brittle and crumbles in thick joints. For its finish-hardening a second component must be added to it as a hardening agent.

Because of their higher price, the PVAc-glues are used as surface glues for special applications only. These glues are almost exclusively employed for assembly-gluing work, since their shorter setting times and good processing properties are not obtained with other glues.

Polyvinyl acetate glues are tough and resilient and they do not become brittle. Through suitable additives, it has been possible to give these glues properties greatly varying on their nature. For example, they can be standardized to setting more or less soft, or for faster and slower speeds. Given properly chosen additions, they will even adhere excellently to lacquered surfaces, so that furniture components may be lacquered before the glue joints are made. PVAc glues have a very high dry strength and the strength factors obtained with them also satisfy high demands such as those to be met in the chair industry, for example.

While it is true that glutin glues make joints in no way inferior to those achieved with synthetic resin glues, the conditions under which they have to be applied are essentially less favorable than those required for synthetic resin glues. All the time they are in use for making joints, glutin glues must be kept at a temperature of approximately 140°F. If this temperature is noticeably lower, the glue will become gelatinous; if it is exceeded, the molecule chains will break up and thus the quality will deteriorate.

For gluing, the wood must be prewarmed, and the glue will not set until it has cooled off. These properties complicate and slow down the flow of the glued work from working place to working place. The short setting times of the PVAc glues cannot be matched by glutin glue. In addition to this, there is the risk that glutin glue will be attacked by bacteria when stored for a long time in rooms that are not very dry.

Mr. Bird is a frequent contributor to leading technical journals in Great Britain.

Wind and weather locked out

Epoxy-Sealed Marine Radios

One of the outstanding plus features offered by an epoxy adhesive, in addition to its efficiency as a chemical fastener, is its ability to provide an excellent seal against a wide variety of environmental conditions. This important advantage is being successfully utilized by the Marine Radio Division of Burlington Electric Corp., Bristol, Penna., in the production of their Marlin 200, a two-band transistor marine radio that will actually play under water.

Of course, the Marlin 200 wasn't really designed to play under water, but its waterproof construction was carefully engineered so that if the radio is accidentally dropped into the water it will not only float but continue to play. As can be seen from this severe dunking test, the radio will easily withstand the effects of rain, wind, spray and continuous exposure to sunlight . . . all the punishing conditions encountered in a lifetime of marine use.

The epoxy used by Burlington Electric is a room-temperature-curing, 100 per cent-reactive adhesive formulated by Rubber and Asbestos Corp., Bloomfield, N.J., and designated as Bondmaster M648. The formulation has been used to solve several production problems involved in the assembly of this marine radio.

The delicate electronic parts of the Marlin 200, as well as its heat-sensitive plastic components, made bonding at room temperature an obvious necessity. In addition, Burlington Electric engineers found that the setting time and cure span of the epoxy formulation fit smoothly into their production cycle.

Special Feature

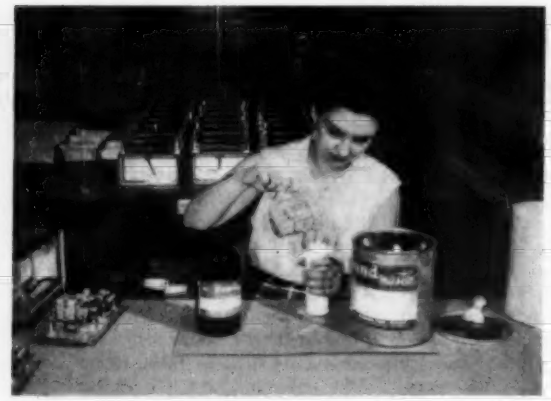
A final recommending feature of the adhesive was its good flow characteristics which make it possible to reach relatively inaccessible parts of the electronic assembly without special equipment. The epoxy, incidentally, is a two-part formulation.

After the proper amounts of resin and hardener are carefully weighed and thoroughly mixed, the adhesive is poured into a common household polyethylene mustard dispenser. Use of this inexpensive "applicator" permits quick and easy "spot" bonding.

One application of the epoxy formulation at Burlington Electric is to seal the ends of the antenna circuit which is built into the Cycolac (high impact polystyrene) handle. The adhesive is also applied at three different places within the unit's aluminum housing to which it bonds the neoprene tubing and the plastic-coated wire of the lead-ins from the antenna handle. After the adhesive is applied, the entire assembly is merely set aside and allowed to air-cure overnight at room temperature.

The assembly room at Burlington Electric is laid out in such a way that production is uninterrupted. Naturally, this scheme is aided by the use of a room-temperature curing system.

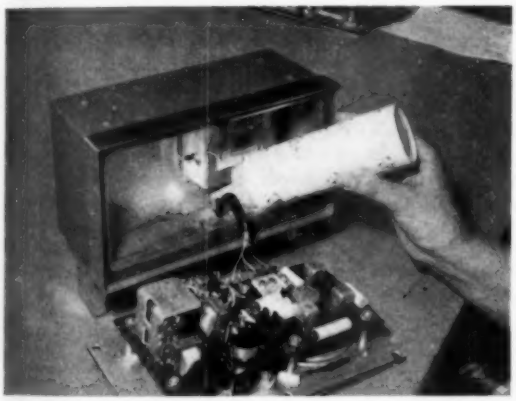
The Marlin 200 provides marine weather every thirty minutes. It can also be used to receive standard broadcast entertainment. The unit is directional for navigation and offers reception within a range of up to 200 miles.



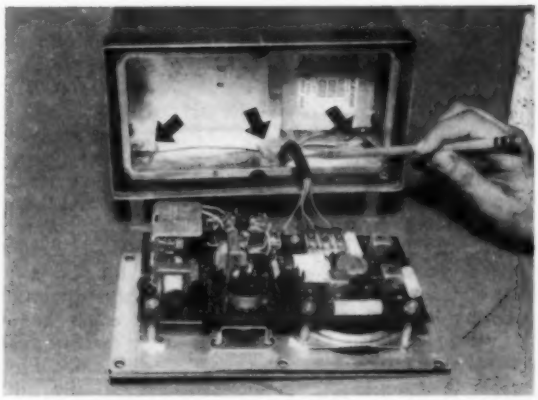
Mixed adhesive is poured into a common plastic squeeze bottle.

Epoxy mix seals the ends of the antenna circuit in the handle.

Burlington's continuous production plant layout profits from use of room-temperature curing system.

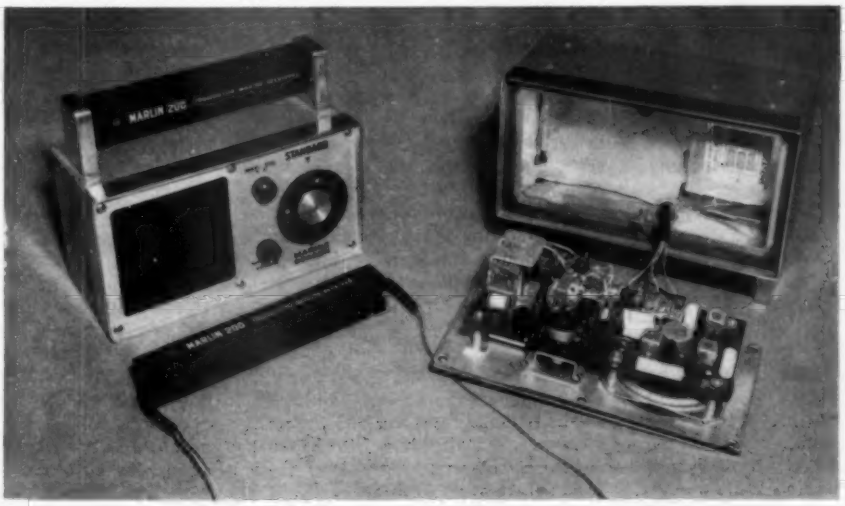


Use of squeeze bottle permits easy interior application of epoxy.



The arrows point to three interior bond and seal applications.

View of the completed radio, the handle containing the antenna, and the set with chassis removed.



By PAUL A. MANOR
Chief Engineer
Central Valve & Research Dept.
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Pittsburgh, Penna.

Coated Valves Fight Corrosion

Rockwell engineers found that the "right" plastic material would not only have to be chemically inert but also strong and easy to apply

Among the adhesives-plant engineer's more vexing problems is the valving of process lines handling corrosive solvents and chemicals. In some installations, corrosion is so severe that valves must be stocked as though they were raw materials, since they can't be expected to last more than a few months.

Specifying materials such as bronze, nickel, stainless steel, etc., increases costs considerably and doesn't necessarily provide for respectively longer valve life. Plating the valve with various corrosion-resistant materials is somewhat cheaper in many cases, but still has to meet most of the objections to straight metal changeover.

A related technique is the use of a plastic coating. Many plastics have unusual chemical inertness and are therefore excellent protectants against corrosion. In addition, plastic coated valves are considerably cheaper than metal or metal-plated units with anything near a similar chemical resistance.

Rockwell engineers spent a considerable amount of time looking into the possibilities and problems of coating valves with plastic. They found that a number of characteristics had to be considered in selecting a plastic coating material.

For example, one consideration of importance was the ease with which the plastic could be applied. This is especially true because valves are irregularly shaped objects and therefore more difficult to coat than general process equipment. On the other hand, if the coating does not cover every spot of the valve's surface, the unit as a whole remains vulnerable to corrosion.

Length of service life was another important consideration that had to be taken into account. The longevity of the valve depends on the coating plastic's good surface adhesion, abrasion resistance, resilient structure, resistance to cyclic wear and the temperature range it can withstand.

Finding a plastic which met all of these requirements was something of a job. Some fit the corrosion requirements completely but were not physically strong enough. Some fit practically all the service requirements but were too difficult or costly to apply to metal.

Tried Phenolics

One of the first materials tried was the phenolic group. They were simple to apply—they could be sprayed on—and had fair chemical resistance and wear characteristics. Unfortunately, however, phenolic is brittle and tests showed that the coating broke too easily in routine plant handling.

Epoxies and modified epoxies were tried next. Also spray-applied, they were a considerable improvement as to brittleness but were below the required standard in resistance to wear in cyclic valve operations.

Polyvinyl chloride showed good chemical resistance and could be applied by the fluidized bed process. However, it had only a 140°F. temperature tolerance and less than satisfactory wear resistance.

The polyfluorohydrocarbon plastics showed the most promising chemical and physical resistances, but it was virtually impossible to get an adequate coating thickness and still keep the cost in line.

The most successful answer to the problem of low-cost corrosion resistance proved to be a chlorinated polyether of high molecular weight. Linear in nature and crystalline in character, the plastic is marketed by Hercules Powder Co. under the name of Penton.

From the very beginning, the chlorinated polyether seemed to be the answer and a variety of tests showed that this was true. We tested its specific gravity, tensile strength, tensile modulus and elongation at 73°F. and 212°F. Flexural strength, flexural modulus and Rockwell hardness were tested at 73°F. Tests were made of Izod impact, notched and unnotched at 73°F., −20°C. and −40 C.

In addition tests were made of the material's water absorption, deformation under load at 122°F. and 2000 psi, compressive stress at one per cent offset, compression modulus, heat distortion, flammability, thermal coefficient of linear expansion, and response to accelerated exposure.

To determine the corrosion resistance of coated parts, steel coupons were coated with an approximately .015" thickness of Penton and immersed in various groups of chemicals for 90 days over a temperature range of 70°F. to 200°F. Using the results of these tests we came up with a rating system for

The coating process used at Rockwell starts with preheating the valve to 500°F. The unit is then dipped into a fluidized bed of finely divided chlorinated polyether powder and baked to final state at 450°F.

representative line fluids. The ratings are given below.

A—The plastic is resistant up to 200°F. For high temperatures, confirmation tests under duplicate conditions should be run.

B—Plastic is resistant to corrosion up to 80°F. Confirmation tests are required for higher temperatures. In some cases plastic discoloration and weight chance may occur, but this is not necessarily indicative of the material's lack of serviceability.

C—Additional information regarding operating conditions required.

D—Not recommended.

Following Up Tests

Field tests with coupons followed up the laboratory work to make sure that the original tests were accurate and to give potential users a chance to evaluate the coating in their own special environments. About 1100 coupons were placed with chemical and petrochemical companies in various parts of the country. The results confirmed our original lab tests.

One of the factors that helped make Penton-coated valves a commercial reality was a new, relatively simple and quick coating process which produces a uniform adherent and void-free coating. Designated as the Whirlclad process, the technique is an adaptation of the fluidized bed method of coating.

The first step in the process is to preheat the valve part to a temperature of approximately 500°F. The part is then dipped into a fluidized bed of finely divided Penton powder for about 25 seconds. During this time, a coating 20 to 25 thousandths of an inch thick is deposited. The coating is then baked to its final state in a gas-fired oven at a temperature of 450°F.

Little pretreatment of the part's surface, other than routine cleaning, is necessary. However, it is necessary to "radius" all sharp edges because the material tends to coat "thin" on a sharp edge.

A static voltage test is used to detect porosity in the coating. This is done in one of two ways:

(1) The valve plug is immersed slowly in an electrolytic bath.

(2) More complex shapes—such as the body—are probed with an electrode.

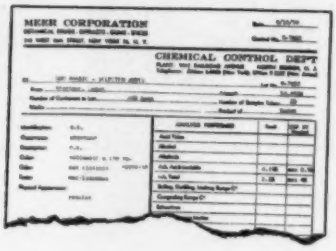
In either case, a current reading would indicate the presence of a pinhole which permitted the electrical circuit to close. Spark testing devices for surveying coating porosity did not prove successful. In too many cases it was found that the instrument gave a false indication as to the quality of the coating.

When 1200 Penton-coated valves were in field operations, a survey showed that only one per cent failed to live up to expectations. Failures were most often mechanical and due to physical damage of the coating by either abrasive material in the line fluid, the use of the valve for throttling, or a combination of both.

Chemical failures were due to incorrect application and were predictable. Line fluids such as hot chlorinated solvents were absorbed by the plastic, causing it to swell. Some of the early failures resulted from pinholes which weren't caught by an earlier inspection routine.

Our three-year evaluation of these valves shows that the Penton-coating provides a relatively broad spectrum of chemical corrosion protection. Because it is also not too difficult or costly to apply, we have found it a comparatively low-cost solution to a wide variety of valve corrosion problems.

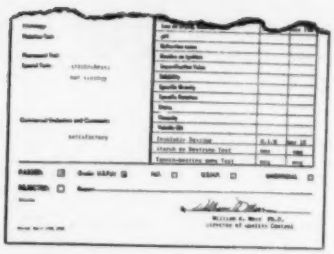
One of the larger Penton-coated lubricated plug valves is shown here used in a heavy-duty chemical installation.


MEER CORPORATION

CHEMICAL CONTROL DEPT

By GEORGE MEER, JR.
Technical Director
Meer Corporation
New York, N.Y.

Quality Control for Natural Gums



A series of controlled tests are used to insure that products such as gum arabic are absolutely consistent from shipment to shipment

One of the prime requirements made by users of water-soluble gums such as gum arabic is that shipments of these natural products be absolutely consistent, day after day, year after year. Accordingly, the Meer Corporation, a leading gum and gum products manufacturer, has developed a rigid quality control system which begins at the gum's point of origin and ends only with its shipment in final form to the user's plant.

Obtained in the form of a dried exudation from trees of the *Acacia* family, gum arabic in powdered form is generally considered a safe, simple adhesive for a variety of paper products. For example, it is often used for envelopes, labels and stamps since these items require an adhesive of a water remoistenable type. Adhesives made from gum arabic meet this prerequisite and offer additional advantages in that they are easy to prepare, light in color and very stable.

However, these advantages are predicated on the assurance that each batch of this natural product reaching the formulator will be consistent with the batch that preceded it. This means that the importer and distributor of these gums, which come from Africa, India, Australia, and Central America must exercise rigid quality control tests at every step along the way.

The first step in Meer quality control is at the collection depots, where a company inspector checks each lot of the raw gum before it is shipped. When the cargo arrives at pierside in this country, it is reinspected by another Meer representative to insure that, among other things, it has not absorbed any odors or tastes from other cargoes in the hold.

Approved lots of gum are forwarded to the Meer plant in North Bergen, N.J., where an "official sample" is taken. From this point on, every step in testing and processing is recorded on a carefully worked out chemical control form, as the new shipment is checked and rechecked against a Meer laboratory standard. The company sets its own gum standards, which are higher than those called for by government regulatory agencies.

Preliminary Checks

Among the first tests to which the official sample is subjected are preliminary checks by Meer pharmacognocist who sees to it that the shipment agrees in color and texture with laboratory-controlled standard specimens of the raw gum and various processed forms.

In another test, a Meer chemist uses an infrared moisture balance to determine the moisture content of the sample. While moisture content does not affect the final performance of the gum, it must be set within limits or customers will in effect be paying for water instead of arabic.

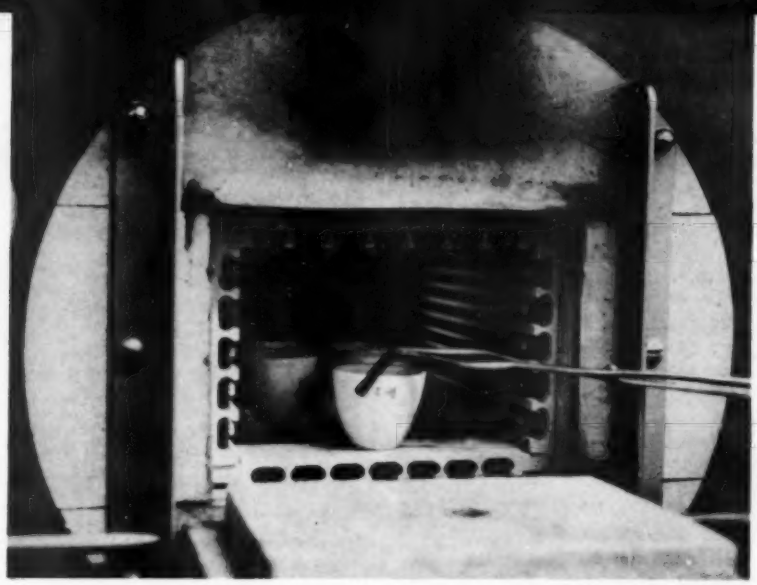
The ash content of the official sample is tested in a muffle furnace. specimens of the raw gum and placed in ceramic crucibles and burned out at high heat without oxygen until only ash remains.

Silica tests are made by placing some of the gum in a special platinum crucible which is then subjected to the high heat of a Meeker burner. Ordinary porcelain crucibles can not be used lest the heat cause the gum's silica content to fuse with the container.

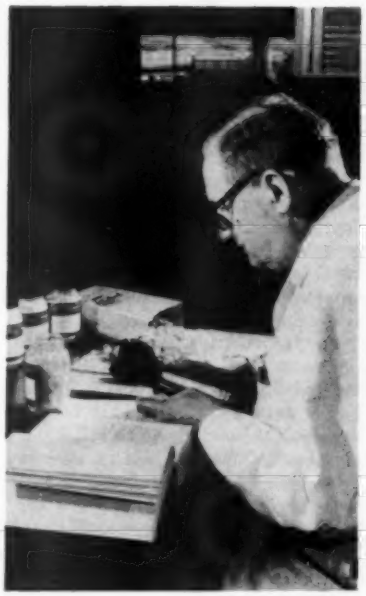
Meer chemical analysis also test the official sample to make sure that it meets company standards for clarity and sediment. This is done by inserting a tube of solution made from the sample and a tube of solution made from a laboratory standard in a centrifuge unit. Tubes are afterwards compared to see that the clarity and sediment of each is identical.

Only when a shipment has passed every required test is it accepted for processing into the crystal or powdered gum which will eventually make its way to Meer customers.

The quality control system which assures such absolute consistency is used by Meer not only in its water soluble gums, but in its full line of more than a 1000 botanicals. It has been studied as a model by many other companies both in and related



A muffle furnace is used to test the ash content of the gum arabic specimen. A sample of the processed gum is burned out without oxygen until only ash remains.



The official sample from a gum shipment is checked against laboratory-controlled specimens as well as processed forms which are used as standards of comparison for every step.

Tests for clarity and sediment are shown being made in the photo on the far right. Tubes containing solutions made from the official sample and the laboratory standards are inserted into a centrifuge unit.

For silica tests, Meer chemists use a special platinum crucible. If ordinary porcelain crucibles were used, the heat of the burner would fuse the gum's silica with them.

to the botanical field, where such controls are essential.

After a gum shipment has passed all the quality control tests, it is ready for processing in the company's new automatic milling and processing system. The set up is capable of producing five million pounds of water soluble gums and gum products a year. Basic to the setup is a three-level air conveying system which eliminates manual handling by mechanically moving the material in process from one operation to another. The conveying lines are powered by a series of compressors and blowers which are built into the production system.

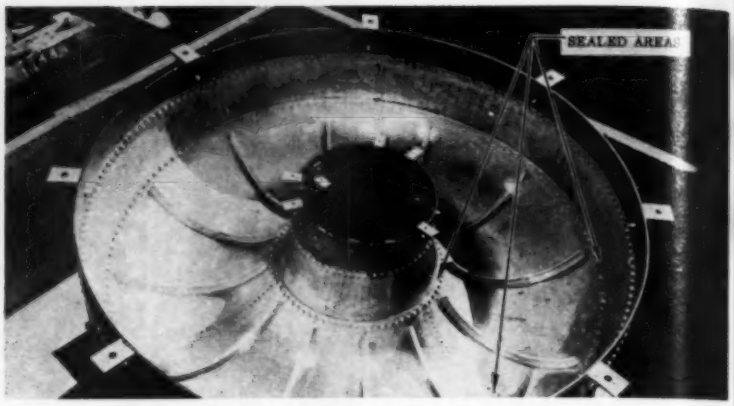
It is possible to bleed off various fractions at any point in the system. In addition, the new operation is designed to discharge, at different stages of processing, finished products, such as fine and coarse powders or crystals.

Essentially, the system consists of seven major components which perform the milling and processing procedures. The scalper removes foreign matter and other impurities from the gum. The latter is then air-conveyed to the crusher which breaks the material into a coarse powder.

This is followed by an air cleaning operation which removes light impurities, such as bark, from the product. The pulverizer then mills the gum to a fine powder after which the air collector separates the air from the product. From here, the gum is moved to a rotary sifter which sizes the finished product. The process is completed with the blending of the material into a uniform product. It is then discharged into the shipping container or drum.

About the Author . . .

GEORGE MEER, *Jr.* is technical director of Meer Corp. and directs its activities in water soluble gums, botanical drugs and extracts, and oleoresins.



The photograph above shows the sealed areas of the pressure bulkheads of the liquid ammonia tank. The X-15 rocket was developed by North American Aviation.

Sealing the X-15

One of the many problems faced by designers of the North American Aviation X-15 research rocket aircraft was that of adequate sealing. Sealants used had to be chemically resistant to a variety of fluids and capable of maintaining their effectiveness over a wide range of temperatures and pressures.

A particularly sensitive application was the sealing of the segmented pressure bulkheads of the liquid ammonia tank. This tank is made of Inconel riveted to 7075-T6 aluminum. The seal aids in assuring proper fluid flow from one compartment to another. To do so, however, it must not only resist the effects of ammonia for extensive periods, but remain serviceable from —40°F. to 300°F. In addition, it must be capable of being applied and cured at a temperature which will not destroy or reduce the aluminum because of time-temperature annealing effects.

After considerable testing of available sealants, North American engineers selected a structural adhesive film designated as Scotch-Weld AF-30. It is manufactured by the Adhesives, Coatings and Sealers Division, Minnesota Mining and Mfg. Co., St. Paul, Minn.

Sealing a pressure bulkhead begins with the application of a thin, even coat of primer to all areas involved. Then, the film adhesive is positioned on the Inconel surface while the primer is still slightly tacky.

The film adheres to the primed surface and can be formed to fit most contour sections. In areas where the film cannot be formed to match the contour of the part, one-quarter inch deep V-shaped cuts are made in the wedge-shaped pieces of bonding film. The wedges are held in position with the primer until the mating part is brought into place. Large structural holes are plug-sealed with hand-formed pieces of AF-30 film adhesive.

To remove any film adhesive covering fastener holes, an Osborne revolving punch is used. The hole in the film adhesive is undercut to leave a 0.005 to 0.010 inch overlap extending into the hole so that the film adhesive will flow along the sides of the inserted fastener, thus completely sealing the fastener.

When parts are ready for final assembly, the backup liner on the film adhesive is removed, and parts are mated carefully so the preplaced bonding film is not disturbed. The prefit aluminum bulkhead is then riveted over the film, to the Inconel.

A leakage check is performed after the mating parts have been assembled, but before the film adhesive is cured. For this check, all access doors are closed and the sealed compartment is pressurized with air at a maximum rate of 8 cubic feet per minute or until a pressure of 2 psi is obtained.

The film adhesive is then cured at 300°F. to 350°F. for two hours. Thermocouples on the heated section ensure that the temperature does not exceed 350°F. After the adhesive is cured, all bolts are retorqued.

Epoxy Compound Used To Resurface Pitted Concrete Floor

A total of 10,600 pounds of epoxy resin, hardener and fine, white flint sand aggregate are used at TWA overhaul base

Typical worn and eroded floor section of TWA engine preparation area. Note original, undamaged surface in upper part of photo.

Though a concrete floor, containing a metallic hardener and boasting a compressive strength of 4000 psi, provides a serviceable surface for most industrial operations, when the loads are five-ton aircraft engines supported by four three-inch crowned castors, the stress can be too much for it. This was the case at Trans World Airlines' 25-million dollar overhaul base at Kansas City, Mo., where giant engines are moved about on transport stands to repair and test areas. The floor was really beat.

Point-Contact Pressures

Because the crowned castors are in essentially point-contact with the supporting surface, actual pressures are anybody's guess—perhaps as much as 10,000 to 15,000 psi. As the surface roughened, a vicious cycle was begun. The loaded wheels, falling from high to low points in the floor, delivered short, punishing blows. The rougher the floor, the greater the distance of fall and the harder the blow. The floor was soon pocked with ruts from a half to two inches deep.

In tests of various resurfacing materials and methods, TWA engineers investigated several epoxy compounds and settled on an epoxy system recommended by Smooth-On Mfg. Co., Jersey City, N. Y. The resin was Bakelite Brand ERL-2795, produced by Union Carbide Plastics Co., New York, N. Y., and the hardener was a Smooth-On product designated as Sonite EC.

The site chosen for a large scale treatment was a 4000-square-foot preparation area in front of a test cell from which and to which engines are constantly being trundled. First, the area was chipped down to solid concrete, cleaned and then etched. A neat coat of an epoxy-hardener mixture was then swabbed on to act as a primer and insure a good bond between the concrete and the final epoxy top coat.

This preparation was followed by a trowelled coat composed of epoxy resin, hardener and fine, white flint sand aggregate.

Curing was allowed to proceed at room temperature. Light traffic was permitted in the area within 24 hours after application of the epoxy compound, and full normal operations were resumed after three days.

A total of 10,600 pounds of troweling compound was applied. The 4000-square-foot area—which was worked on in sections to minimize interference with regular operations—was coated to an average depth of three-eighths inch. Materials and labor costs worked out to be approximately 45 cents and 65 cents, respectively, per square foot.

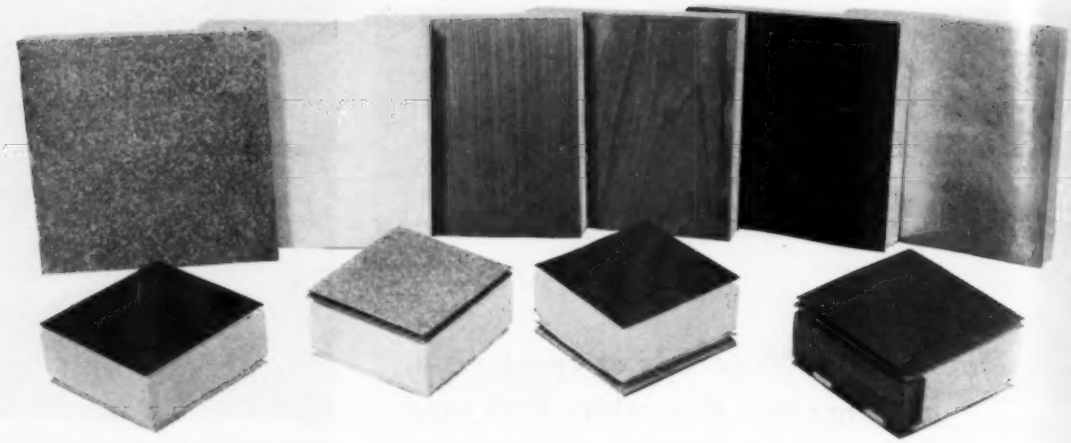
Compressive Strength

The epoxy formulation used has a compressive strength of about 20,000 psi. With such strength, and because it is resistant to oil, grease and other materials used at the overhaul base, the new floor is expected to have an extremely long service life.

TWA's were highly pleased with the epoxy-surfaced floor and have since had two additional areas, totaling 11,000 square feet, repaired.

Prime coat of epoxy resin is applied to the cleaned and etched concrete surface. Engine in rear is on finished resurfacing.

Primed concrete is given single troweled coat of epoxy resin-hardener-flint sand mixture. Preliminary cure is 24 hours.



Aluminum Faced Foamed Plastic Sandwich Panels

By W. L. KRUBSACK, J. D. MINFORD H. F. CAMPBELL and E. T. ENGLEHART

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The advantages of combining different construction materials into a sandwich which possesses properties superior to those of any of the component members have been recognized for many years. Though such sandwiches have found limited application in fields such as the aircraft industry, where large mass production and economy have not been major factors, their use on a large scale basis has been held back largely by the economics associated with methods of fabrication and combination of materials.

Because of their highly satisfactory performance in architectural, transportation, appliance and related fields, aluminum alloys have been recognized as ideal facing materials for use on sandwich panels. With this in mind, Aluminum Company of America has established and conducted an extensive research and development program in an effort to take advantage of the sandwich panel type of construction with aluminum alloys as facing sheets. Such a panel is now a reality and is called Alcoa Alply. This panel possesses many of the advantages of the sandwich type of construction and yet is economical for many conventional applications.

The Alcoa Alply panel consists of a rigid foamed plastic core material to which are bonded aluminum facing sheets by means of an adhesive. Where desired, the inside aluminum facing sheet can be eliminated and any of a variety of other materials bonded in its place. This panel has superior strength-weight characteristics, good insulation value and can be erected simply and quickly by basic joining techniques. It can be used with or without auxiliary framing.

The aluminum facings respond to the same wide variety of finishing processes that give them texture or color, or both, as is the case with aluminum alloys in general. These panels have already been used for some commercial applications ranging from residential structures to the construction of refrigerator boxes.

The Alply panel is fabricated by means of a continuous process whereby the facings and polystyrene beads are fed into one end of a piece of production equipment. Sandwich panels, complete with facing sheets, are taken from the opposite end of the machine. This newly developed manufacturing process permits the panel to be mass produced at a reasonable cost.

A great deal of research went into both the development of a continuous fabrication method and the choice and evaluation of various component parts of the Alply panel.

While many core materials may be used for sandwich panels, emphasis in this article will be placed on polystyrene. Because of its good thermal insulation properties, good resistance to water and to water vapor transmission, relatively high strength with low density and low cost, polystyrene foam has received considerable attention. Another important consideration in the use of polystyrene in sandwich panels has been the relatively long experience with this plastic in service applications.

Polystyrene foams have been made in the past by pressure introduction of a gas such as methyl chloride into molten polystyrene. The mixture is extruded as planks which can be easily cut or worked into almost any desired shape with conventional woodworking tools. In some instances the material has been cut by using a hot wire to melt the polystyrene at the point of contact. Through the proper selection of adhesives and adhesive techniques, these foams may be bonded to wood, metal, masonry, cloth, paper, glass, to themselves or to other plastics.

Most recently, the polystyrene used for sandwich panels is supplied

as granules containing a gas propellant. These beads, as the granular form is called, require much less storage space than foam supplied as planks. When exposed to elevated temperatures, they expand to many times their original size.

The primary advantage of such polystyrene is that it may be molded to fit the contours of insulation areas or any other shape in a simple two-step operation. Another very important advantage of polystyrene stems from its high strength-weight ratio, especially in connection with aluminum facings as in the Alply panel. For example, a typical three-inch panel, four feet by eight feet with 0.025 inch aluminum facings, weighs only 39 pounds. Yet this same panel can support a distributed load of 1500 pounds over an eight foot clear span.

Adhesives are a vital part of all sandwich panels. In only a few cases, such as polyurethane and vinyl foams, for example, may the core material itself double as an adhesive. The well established long-time durability of aluminum is in contrast to the less firmly established durability of the adhesive bond. Because of the importance of durability and stability in both the core and the adhesive, it has been necessary to design special tests to project the length of service life for sandwich panels.

For discussion purposes, adhesives can be divided into the two main classifications: natural adhesives and synthetic adhesives.

Natural adhesives are those whose basic components come from natural gums or from animal sources (usually proteins). The adhesive properties of many of these natural materials were known even 3000 years ago, and many have been in continual use up to the present day. Though the reasonable cost and ease of application of many natural adhesives has increased their general usage in recent times, their use in sandwich panels is very restricted because their structural strengths are usually inferior to many synthetic adhesives. In addition, they cannot be as easily modified to meet special requirements as the synthetic types.

The history of the development of synthetic rubbers and resins extends back over a century. This appears somewhat surprising in light of the many new and significant commercial developments taking place today. It is usually necessary, however, to amass a considerable fund of heterogeneous background information in any area of science before dramatic progress can take place.

The development of synthetic rubbers and resins was no exception to this rule. For example, polystyrene, polyvinyl chloride and polyvinylidene chloride were all prepared in an impure form before 1840. However, except for consideration as chemical curiosities, they were not destined to receive the attention that has been given them since the early 1930's. More intensive research began about the time of the First World War and was the beginning of large scale development work with synthetic resins.

Study of the underlying principles of resin formation (polymerization), which was actively pursued in the period of 1920-1930, furnished the fundamental basis for understanding how to produce tailor-made synthetic adhesives with specific properties. The old problem of producing a variety of synthetic rubbers commercially was actively pursued during the Second World War. During this period of expansion, the research into methods for making polystyrene reduced the cost of that material to a level that makes it difficult for any other core material except paper honeycomb to compete with it economically.

Special tests are developed to assure that the adhesive bond and the plastic core are as durable as the aluminum face

Synthetic adhesives may be broadly classified into thermoplastic and thermosetting types. The strength required in many structural applications has called for the use of the rigid high-strength thermosetting types of adhesives, but many sandwich panels usually require a compromise adhesive offering good structural strength but still retaining some resiliency. In Alply panels, however, the use of polystyrene core often permits the use of a more rigid adhesive than in sandwich panels employing a less resilient core. Therefore, strictly thermosetting adhesives can be used.

Of the thermosetting types, epoxy adhesives are most frequently used in sandwich panels. These adhesives have initial bond strengths far in excess of that theoretically required for the Alply panel. This is certainly true if the assumption is made that any strength in excess of the cohesive strength between the cells of polystyrene is greater than necessary.

However, one of the main disadvantages of epoxy adhesives for this application is the absence of immediate set and cure since it is very advantageous for high speed commercial production to be able to handle and process sandwich panels immediately after joining. The average epoxy requires a considerable time to cure completely, and in a relatively short time at ambient temperature approaches a consistency which makes it difficult to handle in regular mixing and application equipment.

To overcome this difficulty, spray apparatus manufacturers and epoxy manufacturers have cooperated in the development of multiple headed spray guns and appropriate mixing devices which enable epoxy adhesives to be mixed and sprayed in one operation.

The vast majority of adhesives to be considered for sandwich panel fabrication fall in the thermoplastic classification. They can be best discussed by subdividing them into the following groups:

(1) Reclaimed rubber base adhesives

(2) Butadiene-styrene rubber base adhesives

(3) Acrylonitrile rubber base adhesives

(4) Neoprene rubber base adhesives

(5) Polyurethane adhesives

Reclaimed Rubber Base Adhesives—These adhesives have been widely used in a multiplicity of industrial applications. They have, however, two serious drawbacks when considered for sandwich panels like Alply: their inferior aging properties and inferior resistance to bond deterioration in the presence of high humidity. In fact, any of the other four types of adhesives listed above appear to be superior in these particulars—though polyurethane adhe-

About the Authors . . .

W. L. KRUBSACK has been concerned chiefly with applications of aluminum alloys in the architectural field. He attended the University of Wisconsin and received a BS in metallurgical engineering in 1956 and MS in metallurgy in 1957.

JAMES DEAN MINFORD received his BS in chemistry from Carnegie Institute of Technology and a PhD in bio-organic chemistry from the University of Fittsburgh. He has been with Alcoa since 1953 and worked on the combining of aluminum with other metals and high polymer materials with organic and inorganic adhesives.

H. F. CAMPBELL has been engaged in research in the fields of joining and fabrication since employment with Alcoa in 1955. He had previously worked with Bradford Laboratories, Inc., water consultants. Mr. Campbell was graduated from Grove City College, Grove City, Penna., in 1951 with a B.S. in chemistry.

E. T. ENGLEHART is assistant chief of Alcoa's Chemical Metallurgy Division. He has been with the company since 1943 when he graduated from Pennsylvania State University with a BS in chemistry. Promoted to his present position in 1959 Mr. Englehart is the author of several papers dealing with corrosion problems of aluminum alloys.

sives may not yet have been in commercial use long enough to establish their aging characteristics.

Butadiene-styrene Rubber Base Adhesives—These adhesives have higher water resistance and better aging properties than the reclaimed rubber adhesives but are somewhat poorer in these respects when compared to the acrylonitrile and neoprene types. These conclusions have been verified in actual tests using Alply panels fabricated with adhesives from all the above listed types.

Acrylonitrile Rubber Base Adhesives—The aging and water resistance characteristics of these adhesives are very good. Some acrylonitrile adhesives have had excellent field service records and there is sufficient basis for believing that these adhesives would give good service in the Alply panel. The only drawback to the use of such an adhesive in the Alply panel has been that it requires a higher heat reactivation temperature than the polystyrene core material can tolerate. Lower heat reactivating forms of the better acrylonitrile base adhesives are available but have the disadvantage of being more sensitive to water.

Neoprene Rubber Base Adhesives—Adhesives based on neoprene synthetic rubber have been most commonly used for bonding sandwiches, and the major emphasis in the development of the Alply sandwich panel has been in this area. While commercially available neoprene adhesives present a wide range of aging and water resistance properties, they are usually good. A single manufacturer may, for example, have many grades of neoprene adhesives in his line, ranging from one that can withstand repeated immersion in steam with minimum deterioration, to one that would not be acceptable for even a relatively mild exposure to high humidity. Usually, those neoprene adhesives with the highest water resistance will also have high heat resistance and will require heat reactivation at a higher temperature than those with lower water resistance.

Neoprene adhesives have good shear and peel strengths and tend to resist constant stress better than most other rubber adhesives. Strength also develops fast in neoprene adhesive bonds so that low loads can be sustained immediately after bonding even at fairly high temperatures. Exposure to temperatures as high as 200°F. generally has no effect on neoprene adhesives. Also important in many exposures is the good resistance of the neoprene adhesives to ultraviolet light, ozone and weathering, as well as their high degree of resistance to acids, oils, alkalis and aliphatic hydrocarbons. Finally, the neoprene adhesives adhere well to a wide variety of materials. This is important in any sandwich panel program where practical considerations as well as personal preference may dictate the bonding of a wide variety of materials.

Polyurethane Type Adhesives—The science of formulating adhesives of this type is, relatively speaking, still in its infancy. Polyurethane adhesives have been marketed both as one part and multiple part mixtures (usually no more than two parts). Just as there is a wide variation of possible polyurethane core formulations, there is a wide variety of possible polyurethane adhesives. Some polyurethane adhesives have shown good resistance to high humidity in tests connected with the Alply panel program. However, there has been more variation in performance with this type of adhesive than for the synthetic rubber types.

Foaming in Place

Sandwich panel fabrication by the foam-in-place method offers several advantages over the laminating method insofar as adhesives are concerned. One possible advantage is that adhesives with higher heat reactivation properties (therefore adhesives with generally higher resistance to humidity and temperature) can be used in the foam-in-place method. This is often true because the temperature of the steam necessary to expand the polystyrene beads in the mold tends to be higher than the cells can tolerate in the already expanded polystyrene core used for fabricating by the laminating method. Thus, the introduction of this high a temperature into the heat reactivation step for bonding by the laminating method may either lead to a weakening of the cellular structure itself or to a differential expansion of the cells in the preformed core due to the presence of some residual propellent.

The high temperature of the bead expansion process also means that the polystyrene bead is somewhat thermoplastic itself and that the mating of the material with the similarly thermoplastic adhesive on the metal or nonmetallic skin insures a good cohesive bonding of the materials.

In addition, the method makes for a better bonding situation in that the expanding beads will conform to any irregularities in spatial configuration and thus insure uniform bonding of all surfaces.

The following conditions have been arbitrarily selected as requirements for adhesives for use in the foam-in-place method:

(1) The adhesive should be readily adaptable for uniform spraying or for roller coating application.

(2) The adhesive should be one that can be readily dried to a no tack condition with possible storage at this stage if desired for later reactivation.

(3) The adhesive should be reactivatable at steam temperatures necessary to satisfactorily expand the beads.

(4) The adhesive should bond to an aluminum skin with uniform adherence and give uniform failure within the core when forcibly delaminated.

(5) The adhesive should not show excessive creep at 170°F. with a realistic load bearing.

(6) The adhesive should not cause any significant corrosion on the aluminum skins after exposure to 100 per cent R.H. at 125°F. for six months.

Since it is not possible to make all the different intricate shape and size panels necessary for service applications by the continuous foam-in-place method, it is necessary to use the alternative procedure referred to as the laminating method. Three problems arise because of the properties of the polystyrene core.

One problem is related to the sensitivity of the polystyrene to organic solvents used in adhesives. Most of the synthetic rubber base adhesives recommended for structural panels contain organic solvents which would be definitely harmful to the polystyrene if allowed to contact the core surface and so must be removed prior to any laminating procedure. The second problem is introduced by slight irregularities of the core surfaces making it difficult to obtain a continuous bond. Finally, heat introduced to affect adhesive reactivation can lead to damage of the polystyrene core.

Major requirements for an adhesive for bonding by the laminating method would be as follows:

(1) The adhesive should be easy to apply by spraying or roller coating.

(2) All deleterious solvent must be kept away from the polystyrene. This means complete removal of the solvent from surfaces which can contact the polystyrene. Where an adhesive is to be applied directly to the polystyrene core, it must contain a solvent compatible to the core.

(3) The adhesive should be readily adaptable to rotary press operations as well as to static press type operations for mating of the component sandwich parts.

(4) The adhesive should have sufficient immediate tack so that polystyrene cells would be uniformly ruptured if the panel were forcibly delaminated.

(5) The adhesive should not require heat reactivation above the maximum safe temperature for handling polystyrene.

(6) The adhesive should uniformly adhere to the aluminum surface and to the polystyrene surface.

(7) The adhesive should not show excessive creep at 170°F. with a realistic load bearing.

(8) The adhesive should not cause any significant corrosion on the aluminum skins after exposure to 100 per cent relative humidity at 125°F. for six months.

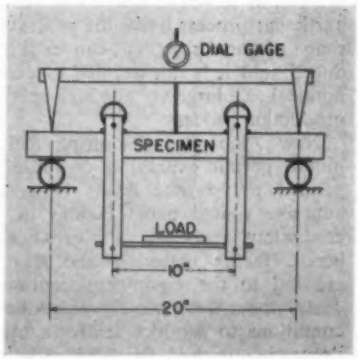
Associated Problems

Much effort has been expended in solving the many problems associated with the development of processes to mass produce integral sandwich panels that are suitable for use as refrigerator components, table tops, curtain walls, load bearing walls, ceilings, roofs, mobile homes, doors, portable coolers and a host of other applications. The almost limitless number of material combinations and properties that are available in this product added to the complexity of the task. Processes have been developed for combining aluminum sheet and extrusions, expandable polystyrene beads, wood and other building materials with adhesives to produce Alply.

Alcoa employs a newly developed continuous manufacturing process to produce Alply panels. The great variety of core materials and the many combinations of facing materials and finishes available demand a versatile and flexible production process.

Expandable polystyrene is received from suppliers in the form of small granules or beads of approximately 40 lbs./ft.^{3} density. These small beads contain a propellant that causes them to expand when they are subjected to heat. The raw beads are pre-expanded by a controlled partial expansion process

Humidity cabinet used in exposure tests at Alcoa Research Laboratories. The cabinet operates at 100 per cent relative humidity and a temperature of 125°F.



Schematic diagram of creep test apparatus. The specimen's top surface was heated to 170°F. by suspended infrared lamps.

Differential humidity-temperature cabinet. Each room can be controlled at different temperatures and humidities to produce gradient across their common wall.

to the density desired for the finished panel core. Pre-expansion can be accomplished by exposure of raw beads to radiant heat, hot air, hot water or steam.

Steam heating affords the most economical high volume production of a uniformly pre-expanded material for Alply. Freshly pre-expanded beads must be aged under controlled conditions in storage bins prior to final production. Aging in screened bins through which air is circulated has proven to be quite satisfactory. Aging time is dependent on the density of the polystyrene beads and varies from one to six days. Pre-expanded beads are moved to any desired location by an airveying system.

Good quality sandwich panels can be produced in a bookmold batch process. Steam is used to fuse the polystyrene core and to serve to reactivate the adhesive when necessary to make a bond between core and facings in a single operation. This particular process limits the practical range of panel sizes that can be produced, and it is not deemed as economical as a large volume high-speed production process.

New Alcoa manufacturing techniques permit expansion of pre-expanded polystyrene beads between adhesive coated panel facings in a continuous process. Pre-expanded beads, facing materials and steam are fed to the equipment continuously under very closely controlled conditions to produce ready to use, decorative finished, flat Alply panels. Panels are normally produced as wide as 48 inches and in thicknesses up to 6 inches. Any convenient or practical length panel can be made. This same process can produce polystyrene core for use in making panels by a laminating process.

Laminating procedures are used to make panels that cannot be produced in the continuous process because of size, shape, special inserts or special finishes. Polystyrene, polyurethane, foamed glass, glass fibers, gypsum board and other materials of these types can be used as panel core materials in the laminating process. Here again Alply utilizes foamed polystyrene plank as a core.

Polystyrene foam is readily worked with conventional woodworking tools. The assembly line lay-up process provides stations for shaping and/or sizing the core, applying and drying adhesive on facings and/or inserts, assembling the components and effectively bonding the assembly in a rotary or stationary press.

Roller coating and automatic spray equipment are used to apply adhesives in Alply production. A versatile drying tunnel that removes adhesive solvents under closely controlled conditions of time, temperature and air movement over adhesive coated surfaces has been designed as a component of the Alply production process.

The final bond in laminating panels may be accomplished by either rotary or stationary pressing operations. The adhesive employed determines which pressing process is more practical. Epoxy adhesives normally require a stationary type press for bonding, while contact or heat reactivatable adhesive bonded sandwiches are handled through rotary pressing equipment. Reactivation of adhesives is effected by high intensity heat applied to the composite under pressure.

Special Tests Devised

Because of the wide variety of applications in which sandwich panels are used, it was necessary to devise special tests to predict their performance under service conditions. Analysis of the proposed applications revealed three primary environmental factors: moisture, temperature and stress. Any or all of these factors may be present and may be constant or variable. Performance tests were designed using combinations of these factors.

During preliminary tests, it was realized that in the absence of moisture limited temperature variations did not adversely affect the panels. The presence of high humidity, on the other hand, was deleterious to many panels, and the effect of the environment seemed to increase as temperature and humidity were increased. In many cases, a cyclic variation of temperature and humidity was more severe than a constant environment. Consequently, critical acceptance tests included environments of both static and cyclic nature. In the cyclic tests, an upper limit of 170° F. was placed on temperature. The high humidity exposure was maintained at 100 per cent relative humidity and 125° F.

Four major test procedures were established as laboratory standards for the performance of sandwich panels. These tests were conducted on experimental panels to determine whether various panel components and fabricating procedures might be used in the production of commercial panels. One cyclic test, which was used as a standard acceptance test, employed a 24 hour cycle consisting of 16 hours in 100 per cent relative humidity at 125° F., two hours in air at 15° F., and six hours in air at room temperature. In order to be acceptable, a panel had to retain its structural integrity throughout 120 such cycles.

Interest in the performance of panels at greater temperature extremes resulted in the development of another cyclic test. This cycle was identical to the first except that the exposure to cold air was carried out in a dry ice chest at −30° to −50° F. and the warm air exposure was circulated air maintained at 170° F. The elevated temperature served to produce a greater variation in moisture content inside the panel by driving out moisture not ordinarily removed at room temperature in the standard cycle.

A performance test originally developed for determining the compatibility of aluminum with nonmetallic materials was also used. This consisted of a six-month exposure to 100 per cent relative humidity at 125° F. In addition to investigating the stability of the panel, this test was used to determine if the facings would be susceptible to attack from the inside.

The fourth test set-up used a special piece of equipment consisting of two rooms with a common wall between them. Temperatures and humidities in the two rooms could be varied independently. One room was held at a relatively high temperature and humidity to simulate conditions inside a building, while the other room was held at a low temperature and ambient humidity to simulate outdoor conditions. In this way, temperature and humidity gradients existed across the common wall.

Samples of sandwich panels were placed in the common wall to permit studies of moisture transfer through the panels or migration of residual moisture within a panel and their effects. In addition, the apparatus was constructed from sandwich panels and is performing well.

Prevention of moisture entry into finished panels became important because of the marked effect of moisture on performance. This would generally be accomplished by incorporating vapor barriers at the panel surfaces (aluminum sheet or foil) and by constructing leak-proof joints between panels. A further safety factor would be obtained with a core material that was relatively impervious to moisture.

Water vapor transmission tests conducted on polystyrene core material according to ASTM Specifications C-355-54T and E96-53T produced the data for Figure 1. Resistance to water vapor transmission was proportional to foam density. Polystyrene foam with density of 2 lb./ft.^{3} (nominal polystyrene foam density for most panel applications) had an average water vapor transmission rate of 1.5 to 2.0 perm-inches (grain-inches/square foot-hour-inch mercury of vapor pressure differential). This value is relatively low by comparison with most insulating materials.

Mechanical tests were conducted on the experimental panels to determine if the strength of the adhesive bond between core and facing was adequate. The panels were also tested for resistance to creep (in the adhesive) at elevated temperatures. A specimen with width at least two times the thickness and length at least four times the thickness was supported as a simple beam with a 20-inch span and loaded at the quarter points to a shear stress of 0.2 psi. This value was selected as being in excess of the shear stress in a 4 foot x 8 foot panel supporting its own weight. The top surface temperature of the specimen was maintained at 170° F. with a bank of heat lamps and the test was continued for five days, the first day's data being excluded from the calculations. A panel whose creep rate was less than 0.0005 inch per hour, as measured by the amount of deflection at the center of the specimen, was considered satisfactory.

Since tests had proved that the foamed plastic suffered no measurable loss in mechanical strength during any of the tests, evaluation of the performance of a particular panel exposed to the cyclic and humidity tests was determined by visual examination when the facings were stripped from the panels after the test period was completed. The ideal panel assembly, of course, was one in which the foamed plastic core material was initially the weakest component of the panel and had continued to be throughout the testing procedures.

Accordingly, an ideal panel assembly, when disassembled before or after testing, should show 100 per cent of the failure occurring in the foamed plastic core material. Failure in any other area, such as the core-adhesive or facing-adhesive interfaces, would indicate that area to be weaker than the foamed core.

The primary function of the exposure tests was the evaluation of the performance of the adhesive used to bond the facing and core together. Weaknesses encountered in the adhesives fell into four categories:

(1) Failure of the adhesive to adhere to the core.

(2) Failure of the adhesive to adhere to the facing material.

(3) Deterioration of the adhesive itself, *i.e.*, significant changes in physical and mechanical properties.

(4) Promotion of deterioration of the facings by the adhesive.

The most frequently observed type of adhesive problem was failure of the adhesive to adhere to the core. A panel disassembled after exposure would show the adhesive clinging tightly to the facing with only slight traces of adhesive remaining on the core material, yet the adhesive itself showed no signs of deterioration.

Failure of the bond between the adhesive and the aluminum facing was encountered far less frequently. The epoxy resin adhesive types seemed to be most susceptible to this type of weakness. In some of these cases, however, it appeared that the failure was at least in part due to improper preparation of the aluminum sheet or improper application of the adhesive.

Deterioration of the adhesive itself was encountered with several of the rubber-resin-solvent types of adhesives. The adhesive, in this case, had lost all of its elastic properties and became flaky or crumbly. This type of deterioration occurs in the presence of abundant moisture and its rate is accelerated by increasing the temperature. It has not been observed where moisture was not present in quantity.

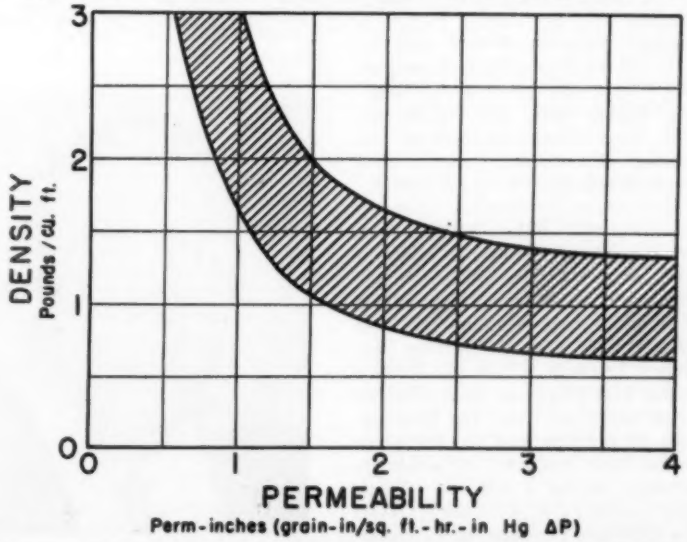
Some corrosion of the inner surfaces of the aluminum facings was observed when certain adhesives were used. The corrosion in all cases was very shallow, but it was felt that the appearance of any corrosion over the short test intervals was undesirable and those adhesives which promoted corrosion were labelled unsatisfactory. Most of the adhesives which promoted attack of the aluminum were of the latex-emulsion type, but there were certain proprietary formulations of each type of adhesive that presented this problem.

Most adhesives were able to pass the test for creep resistance at elevated temperature. In every case, an adhesive that failed this test also performed very poorly in the exposure tests.

The neoprene-resin-solvent adhesives were found to be most suitable for the fabrication of Alply panels. Satisfactory adhesives for limited use were also found in the Acrylontrile resin-solvent and epoxy resin types. However, only a restricted number of adhesives in each classification was acceptable.

The above article is based on a paper originally presented before 136th meeting of the American Chemical Society.

Figure 1—Water Vapor Transmission of Polystyrene Core



Adhesive Council Meets in Cleveland; Warmer Elected to Presidency

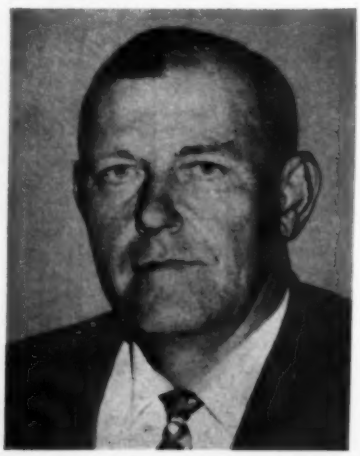
B. F. Warmer, president of the Coast Pro-Seal Mfg. Co., Los Angeles, Calif., was elected president of the Rubber & Plastic Adhesive & Sealant Manufacturers Council (Adhesive Council) at the organization's Fall meeting in Cleveland, Ohio, September 29-30, 1960. He will succeed H. L. Dixon, B. F. Goodrich Co., Akron, Ohio.

Other officers elected to assume office for one year on December 1, 1960, were: 1st vice-president—J. W. Brush, Jr., Raybestos-Manhattan, Inc., Bridgeport, Conn.; 2nd vice-president—D. G. Williamson, Williamson Adhesives, Inc., Skokie, Ill.; 3rd vice-president—H. W. Hibbert, Pecora, Inc., Philadelphia, Penna.; treasurer—F. M. Jeffe, Pierce & Stevens Chemical Corp., Buffalo, N. Y. H. L. Dixon, B. F. Goodrich Co., Akron, Ohio, and F. C. Johnston, Caram Mfg. Co., Monrovia, Calif., were elected to serve on the Steering Committee, representing members-at-large.

More than 70 persons attended the meeting's Sales Management Seminar which featured a program of eight related topics. The seminar was under the chairmanship of John W. Winkler, vice-president of Coast Pro-Seal Mfg. Co. It began on September 29, with a talk by William Angus, vice-president, sales (Rubber & Asbestos Corp.) on "The Development of Markets and the Introduction of New Products." At luncheon, members heard a talk on "Space Suits" given by R. C. Colley (Aviation Products Division, B. F. Goodrich Co.).

The session resumed with a discussion of the "Sales Approach to Warranties, Guarantees and Liabilities." The speakers on this topic included Lee L. Blyler (Howe & French, Inc.), Howard Ellerhorst, Jr. (Angier Adhesives) and A. J. Slosser (Armstrong Cork Co.). "The Role of Technical Service in Sales" was covered by Greg D. Merhige (Templar Oil Products Co., Inc.), John McKinnon (Permalastic Products Co.) and Walter Lahey (B. F. Goodrich Co.).

Continuing after dinner, the seminar went on to present a discussion on the various aspects of "Sales Mechanics" by C. A. Kelley (Minnesota Mining & Mfg. Co.) and George Teplansky (St. Clair Rubber Co.). The meeting wound up with a talk on "Discounts—Their Use and Misuse" by Robert C. Keck (McLeish, Spray, Price and Underwood).



B. F. Warmer

The second day of the seminar began with a talk on "Advertising and Promotion—Planning and Execution." Speakers were E. R. Falkenburg (Miracle Adhesives Corp.) Jerome W. Brush, Jr. (Raybestos-Manhattan, Inc.) and Henry E. Norton (Williamson Adhesives, Inc.).

"Handling of Customer Complaints and Returns" was the subject of a discussion by W. J. Dugal (Chicago Mastic Co.), J. C. Profita (Narmco Materials Division) and D. W. Markham (Products Research Co.).

R. O. White (Caram Mfg. Co.), Reginald C. Whitson (Hysol Corp.) and A. G. Battaglia (National Starch and Chemical Corp.) spoke on "The Problem and Handling of Samples." The seminar then concluded with a discussion by W. J. Bole (Pecora, Inc.) and Harold Pilskaln (Tremco Mfg. Co.) on "The Problems of Distribution."

During the business session of the organization, four new companies were accepted for membership effective October 1, 1960. The companies are Battenfeld Grease & Oil Corp., Inc., Kansas City, Mo.; Furane Plastics, Inc., Los Angeles, Calif.; Franklin Glue Co., Columbus, Ohio, and W. W. Henry Co.

The next meeting of the Adhesive Council will be held December 1-2, 1960, at the Edgewater Beach Hotel, Chicago, Ill.

Packaging Seminar Held

A seminar, intended to "radiate the latest developments in corrugated packaging problems and their solutions discussed by the seminar panelists," sponsored by Stone Container Corp., Chicago, Ill., was held in Philadelphia, Penna., on October 5. Speakers at the seminar included representatives of Aluminum Corp. of America, DeWalt, Inc., Dixie Cup Division of American Can Co., General Electric Co., Globe Rubber Products Corp., and Rockingham Poultry Marketing Cooperative, Inc.

Hugh R. Johnson, director of materials for DeWalt, Inc., Lancaster, Penna., told the assembly how his firm saves $30,000 each year as a result of its latest change in shipping containers. George Heitz, assistant general manager of Rockingham Poultry Marketing Cooperative, told of shipping poultry to market in recently developed, water-resistant, corrugated containers. Lee Pritchard, national packing specifications supervisor for Dixie Cup, Easton, Penna., described improved results obtained through use of a sturdier, lighter, corrugated shipping container.

Harry W. Fritts, manager of the Packaging Section of the Sales Development Division of the Aluminum Co. of America, Pittsburgh, Penna., discussed advantages of combining the functional qualities of aluminum foil and corrugated containerboard. Robert H. Brooks of Brooks and London, advertising agency, told of the use of multi-colored corrugated shelf packages for automotive consumer products, by his client, Globe Rubber Products Corp., Philadelphia, Penna. Development of the "Handle With Pride" packaging theme of General Electric Co., Schenectady, N.Y., was explained by John A. Russo, account designer-packaging, Industrial Design Operation, Housewares Division.

Protectoseal Dispenser

Protectoseal Co., Chicago, Ill., has introduced a dispensing can for toxic solvents, which is designed to protect the user from accidental contact with toxic liquids used in cleaning and finishing operations, and to eliminate toxic vapor hazard by an automatic, self-sealing well. The Toxic Solvent Can has a wide, low base for maximum stability. Terne plate construction provides an inside-and-out lead coating for resistance to corrosion. The standard finish is high gloss, solvent-resistant, baked-on yellow enamel.

C. Cialdella

J. P. Hornburg

H. J. Markowski

Three Appointed By Hysol

Hysol Corp., Olean, N. Y., has announced two promotions and an addition to its staff. Dr. Cataldo Cialdella has assumed the responsibility of director of research and development, James P. Hornburg has become supervisor of technical services, and Henry J. Markowski has joined the company's laboratory staff. Dr. Cialdella, who received his doctorate in chemistry at Case Institute of Technology, was with Bausch and Lomb and Esso Research Co. before joining Hysol as director of research early in 1958.

Mr. Hornburg received an M.A. in chemistry at St. Bonaventure before joining Hysol in 1950. He now assumes responsibility for customer service, physical and electrical testing, quality control, and manufacturing liaison. Mr. Markowski is a graduate of Providence College, and has been associated with Lowe Bros. Paint Co., Dayton, Ohio, and Allied Chemical and Dye Corp., Hopewell, Va. He assumes responsibility for Hysol's product development program on high heat resistance of epoxy resins.

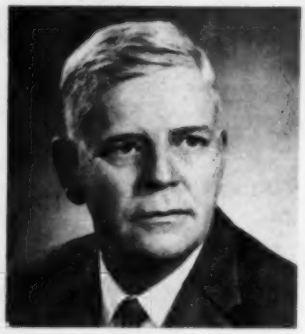
ASA Approves Sealant

The first guide to acceptable performance of polysulfide sealing compounds for the building trade has been approved by the American Standards Association. Entitled "American Standards Specification for Polysulfide Base Sealants for the Building Trade," the specification, which became effective on July 27, 1960, is coded A116.1-1960. The specification provides architects, specifiers and contractors with a practical set of yardsticks against which sealing compounds can be measured. Sealant specifiers can now know the minimum performance to be expected from a polysulfide base compound which meets the specification and which has been properly applied.

The specification covers application of polysulfide to concrete, aluminum, stainless steel and glass surfaces, but can be used as a frame of reference by specifiers for suggested minimum performance of sealants on other structural materials. Copies of the specification are available from the American Standards Association, 10 East 40th St., New York 16, N.Y. Thiokol Chemical Corp., Trenton, N.J., manufacturer of the raw material polysulfide liquid polymer, is making available single complimentary copies to interested parties on written request.

Monsanto Price Rise

Monsanto Chemical Co., St. Louis, Mo., has announced price increases ranging from ¼¢ a pound to 1½¢ a pound, on all Resinox phenol-formaldehyde liquid and solid resins and adhesives. The ¼¢ increase applies to standard 30 per cent solids adhesives used to manufacture fir plywood. The 1½¢ increase will affect powdered resins, such as those used in foundry and abrasives industries. Corresponding increases were announced for more than 75 other special types and formulations in the product group.



John E. Rutzler

Dr. John E. Rutzler, Jr, associate professor of physical chemistry at Case Institute of Technology, Cleveland, Ohio, and a leading expert on adhesives and bonding, died of a heart attack on October 10 at the Lawrence Hotel in Erie, Penna. Dr. Rutzler was stricken and died minutes after concluding a talk before a conference held by the Rubber & Plastics Division of the American Society of Mechanical Engineers. He was 56 years old. Dr. Rutzler was born in Brooklyn, N.Y. He attended Cornell University, where he earned his B.S. and M.S. degrees in chemistry as well as his Ph.D. Prior to joining the Case Institute faculty in 1946, he was assistant professor of chemistry at Carleton College, Northfield, Minn.

Dr. Rutzler had authored and published more than three dozen different papers in the physical chemistry field. He was noted for his knowledge of adhesives, particularly the bonding by chemical process of two substances. He was the author of the article "Types of Bonds Involved in Adhesion," which appeared in the June and July, 1959, issues of ADHESIVES AGE. In May, 1960, Dr. Rutzler received a $56,400 two-year grant from the Wright Air Development Center for a fundamental study of the "effects of molecular structure on mechanical properties of structural adhesives." In the past school year he went on a national speaking tour for the American Chemical Society, addressing students on his favorite topic—adhesives.

He was a member of the American Society for Testing Materials, and was, at the time of his death, chairman of ASTM Committee D-14 on Adhesives. He also was a member of the American Chemical Society, the New York Academy of Sciences, the American Association for the Advancement of Science, and Sigma Xi, an honorary fraternity for undergraduates and professionals outstanding in research. Dr. Rutzler lived in Cleveland Heights, Ohio, and is survived by his wife and three children.

Adopts Hallmark Seal

A new Hallmark seal of quality designating high-quality automobile undercoating material has been adopted by the Automotive Undercoating Manufacturers Association, Pleasant Ridge, Mich. The Hallmark will be awarded to products of manufacturers of undercoating materials that meet or exceed AUMA standard specifications. According to an Association spokesman, the reasons for compiling the new standards and Hallmark seal are to insure that undercoating products meet the required quality and performance levels. Both members and nonmembers of the Association are entitled to use the Hallmark on each product that has been tested and approved by the AUMA.

U B S Names Two

Harold O. Walsh has been named personnel director, and Kenneth King Jr., manager of commercial development, of U B S Chemical Co., Cambridge, Mass. A graduate of Northeastern University, Mr. Walsh holds a B.A. in economics. He was associated with Corning Glass Works Division, Central Falls, R.I., as an employment and training supervisor from 1956 to 1958. During the past two years he has been personnel manager of Knox Glass, Inc., Dayville, Conn.

Mr. King is a recent graduate of the Massachusetts Institute of Technology and holds an M.S. in industrial management; and a B.S. in chemical engineering. Before receiving his graduate degree he was associated with the Polymer Corp.

Reichhold Visits Europe

Henry H. Reichhold, president and general manager of Reichhold Chemicals, Inc., White Plains, N.Y., recently returned to the United States after a six-week tour of the European Common Market. He reports that the European chemical industry is booming along with the general upsurge in all businesses throughout Europe. The main purpose of the European tour, Mr. Reichhold states, was for a periodic check of Reichhold Chemicals' many European interests.

Mr. Reichhold visited a new phthalic anhydride plant and research and development building at Hausen bein Brugg, Switzerland; a new plasticenter for research and development in Hamburg, West Germany; and a new plant producing maleic anhydride at Niort, France. In Holland, Mr. Reichhold completed the purchase of a large tract of land in 's-Hertogenbasch on which is to be built a chemical plant to be operated by the newly-formed company, Reichhold Holland.

In Munich, West Germany, he completed plans for the manufacture of vinyl acetate monomer under a license agreement between Reichhold Chemicals and Wacker Chemie G.m.b.H. This production will be handled by a new plant being built by Reichhold in Houston, Texas.

M-P Completes Plant

Construction of a new starch processing plant built by Morningstar-Paisley, Inc., at Cary's Mills Houlton, Me., has been completed, and the $1.5 million plant is expected to be turning out the first commercial-scale quantities of potato starch ethers to be produced in the United States by January, at a rate of 300 tons per month. A number of other chemically modified potato starches are scheduled for production by Morningstar in the company's project to streamline the production of potato starch products and derivatives, and to make them more competitive with cereal and tapioca starches.

Industrial Symposium

Quantum, Inc., Wallingford, Conn,. will hold its Fall industrial symposium, to be on the theme of "Growth Through New Products," on November 17 at the Yankee Silversmith Inn, Wallingford, and on November 29, at the Harvard Club, Boston, Mass.

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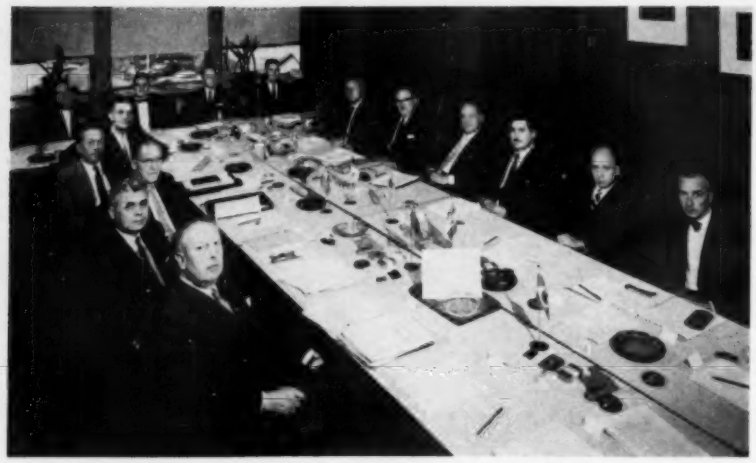

B. B. Chemical Co. managers at the company's 4th annual management conference included, left to right: Donald E. Stark, Kenneth W. Ogden, Gerald C. Maguire, Karl A. Bunke, W. A. Alexander, Kenelm W. Winslow, Donald E. Houser, Roger T. Perkins, Dr. Edwin T. Mitchell, Jose Aubet, Donald E. Cameron, Dr. Hellmuth Herrmann, Keith I. D. Macdonald, John E. Webb, and Ernest G. Wiggins.

B. B. Chemical Holds Meeting

B. B. Chemical Company officials from ten foreign countries met with the host company recently during the firm's fourth annual worldwide management conference at its Cambridge, Mass., headquarters. Among those participating in the conference were—from United Shoe Machinery Corp.: John W. Coolidge, vice-president; Wilson Palmer, vice-president; C. R. Todd, vice-president; Thomas D. Welch, assistant general manager; Raymond L. Belliveau, Fred H. Brown, Donald E. Houser, John H. Meyer and Edgar H. Moor, International Division; Charles F. Gardner and Fred H. Bush, regional representatives for the European and Latin American areas, respectively; from B. B. Chemical: Roger T. Perkins, president; Kenelm W. Winslow, administrative assistant; Dr. Edwin T. Mitchell, assistant general manager, and Ernest G. Wiggins, sales manager.

Visiting B. B. Chemical representatives included: W. A. Alexander, chairman, B. B. Chemical Co. of Australia Pty., Ltd., Victoria; Jose Aubet, manager, Compania de Tintas Boston, S.A., Barcelona, Spain; Karl A. Bunke, managing director, B. B. Chemical Co., AB, Helsingborg, Sweden; Donald E. Cameron, chairman and managing director, B. B. Chemical Co., AB, Hel-Leicester, England; Dr. Hellmuth Herrmann, manager, Boston Blacking Co., G.m.b.H., Oberursel/Taunus, Germany; Gerald G. Maguire, president, and Kenneth W. Ogden, general manager, B. B. Chemical Co. of Canada, Ltd., Montreal; Keith I. D. Macdonald, managing director, B. B. Chemical Co. (South Africa), Pty Ltd., Port Elizabeth; Donald E. Stark, president and general manager, Compagnie de Produits Chimiques "Boston," Epinay-sur-Seine, France; John E. Webb, manager, United Productos Industriales, S.A. de C.V., Mexico City.

During the week-long conference, designed for planning of the company's continued growth and diversification, B. B. managers toured facilities at Middleton, Mass., as well as the United Shoe Machinery Corp. headquarters in Beverly, Mass. Field trips to manufacturing plants of other companies in the Boston area were also part of the program.

Reichhold to Expand

Reichhold Chemicals, Inc., White Plains, N.Y., has announced plans to expand its facilities in Jacksonville, Fla., to include a ten million pound per year combination unit for the production of polyester and alkyd resins. Additional laboratory space will be provided to accommodate increased personnel. The new manufacturing unit, to cost about half a million dollars, is intended to make polyester and alkyd resins more readily available to industry in the South East.

Borden Names Moffitt

William R. Moffitt, previously vice-president and technical director of the Chemical Division, has been appointed senior vice-president for manufacturing and engineering of Borden Chemical Co., New York, N.Y. Mr. Moffitt, a graduate of the University of Pittsburgh, has spent his entire business career with Borden Chemical. He joined the firm's chemical laboratories in 1938 as a chemist, upon completion of two years' work as a fellowship assistant at the Mellon Institute. Mr. Moffitt helped start Borden's first resin production plant in Bainbridge, N.Y., in 1939, and set up another similar facility in Seattle, Wash., the following year. He joined Borden's development staff in Seattle in 1942 and by 1948 had advanced to the position of chief chemist.

In 1950, Mr. Moffitt was appointed western technical director, heading up development, engineering and technical service. He moved up to assistant manager of the division's west coast operations in 1953, and subsequently to manager. In 1954, he was appointed vice-president and technical director of Borden Chemical.

Montecatini Stock Offer

Montecatini Societa Generale per l'Industria Mineraria e Chimica Anonima, Italian firm, has mailed subscription warrants of rights to subscribe for four new American shares for each eleven American shares held of record at October 3, 1960, to American shareholders. The subscription price is $16.13 per American share, and the offer will expire on October 28. The American offering is made in connection with an offering of 40 million capital shares currently being made in Italy by Montecatini to its capitol shareholders.

Appointed by Conap

Mark V. Goodyear, a graduate of Cornell University with several year's experience in synthetic resin application and development, has joined Conap, Inc., Olean, N.Y., as manager of chemical development. Associated with Union Carbide Corp., New York, N.Y., for five years, working on vinyl resin technology, he has, for the past ten years, been working primarily with epoxy resin applications and developments as technical director of Hysol Corp.

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Borden Names Two

Gerry P. Re has been appointed technical service manager, and Howard J. Wood, plywood service representative, of the Western Operations Department of the Borden Chemical Co., New York, N.Y. Mr. Re is a graduate of the University of Portland, and holds B.S. and M.S. degrees in chemistry. He joined Borden Chemical in June 1953 as a field service representative to the plywood industry. He joined the Western Operations plywood sales force later in 1953, and in 1959 he was transferred into sales and technical service for the particle board and hardboard industries. In his new post he will be responsible for technical service of the company's plywood accounts in the Grants Pass, Ore., area.

Mr. Wood graduated from the University of California with a B.S. degree in forestry, and he holds a masters in business administration from San Bernadino Valley College. He was with International Paper Co. from 1951 to 1960, in a statistical post. He will now make his offices at Borden Chemical's plant in Springfield, Ore.

Borden Adds Products

Elmer's Epoxy Glue and Elmer's Floor Grip have been introduced to consumer markets by the Borden Chemical Co., New York, N.Y. The company's epoxy glue kit contains resin and hardener, packaged in individual metal squeeze tubes on a blister card. The Epoxy Glue is described by the company as an extremely strong, clear, waterproof, easy to use adhesive for such varied surfaces as metals, china, glass, porcelain, wood, tiles and most plastics. Also being released for national distribution is the new synthetic latex rug backing compound, Elmer's Floor Grip, for application to the backs of throw and scatter rugs to prevent slipping and skidding of the rugs, as well as for other uses. The product comes in 4 and 8 ounce polyethylene squeeze bottles.

Morningstar Sales Up

Morningstar-Paisley, Inc., New York, N.Y., reports that its sales for the first six months of 1960 totaled $13,371,790, compared with $12,800,900 for the same period of 1959. The firm's net income for the 1960 six-month period amounted to $358,969, earning 71¢ per share of common stock. Net income for the like 1959 period was $320,509, equal to 64¢ per share.

J. A. McAnally

Named by Fuller

Joseph A. McAnally, formerly technical director, has been named assistant manager of H. B. Fuller Co. of Georgia. Mr. McAnally, who has been with Fuller for the past nine years, received his B.S. degree in chemical engineering from Brooklyn Polytechnic Institute. He was employed for 10 years by Bingham Bros. Co., and following Fuller's purchase of the Bingham Adhesives Division in 1951, Mr. McAnally was named head chemist at the Linden, N.J., plant. He was appointed technical director of the Atlanta plant in January 1959.

Container Corp. Merger

An agreement for the merger of the Mengel Co. into Container Corp. of America, Chicago, Ill., has been adopted by the board of directors of the latter company, with the recommendation that the firm's shareholders approve the merger at a special meeting to be held on November 7. The merger will become effective after approval by holders of two-thirds of the shares of each company. Container Corporation's directors have authorized an exchange ratio of two shares of the company's common stock for each share of Mengel common.

Eastman Adds Company

Tennessee Eastman Co., Kingsport, Tenn., has expanded its research program through the creation of a new company, Eastman Research A.G., a Swiss corporation with offices and laboratories in Zurich. Facilities of the new company will be completed by the Spring of 1961.

Enjay Offers Buton

The Enjay Chemical Co., New York, N.Y., has announced the availability of commercial quantities of its new Buton resins from its plants in Baton Rouge, La., and Bayonne, N.J. Initial capacity is 10 million pounds per year, but Enjay reports that capacity can be expanded by several times that amount. Three forms of the new resins are available: Buton 100, 200, and 300. Buton 100 is the basic polymer, composed of 80 per cent butadiene and 20 per cent styrene. It has a low molecular weight of 8,000 to 10,000, high saturation, and an iodine number of approximately 300. Buton 200 and 300, modified polymers, are manufactured by reacting Buton 100 with a polarizing agent in the presence of a catalyst to introduce polar hydroxyl and carbonyl groups. Uses suggested by the company include application in: appliances, industrial, furniture and machine finishes; metal and automotive primers; drum enamels; and can, pipe, tank, gasket and wire coatings.

Develops Tylac Series

The Chemical Division of International Latex Corp., New York, N.Y., has developed a new Tylac series, 3500, designed to provide a better latex adhesive for the needs of the paper coating industry. Improvements, according to the company, include superior dry pick resistance, gloss, wet rub resistance, and wet pick resistance. Economies, it is said, can be achieved at lower latex levels with no sacrifice in coated paper properties. The new series is a modified butadiene-styrene latex which improves adhesion, wet rub resistance, smoothness and gloss, and, the company reports, shows excellent mechanical stability in tests.

Maraweld Approved

The Maraweld process developed by the Marblette Corp., Long Island City, N.Y., a method of repairing fuel oil storage tanks, has been granted official approval by the New York City Board of Standards and Appeals, under Calendar Number 107-60-SM. The Industrionics Co., New York, N.Y., has been franchised to warehouse Maraweld materials in New York City, and service tank repair organizations in the metropolitan area and elsewhere in New York State, New Jersey, Delaware, and New England.

Fuller Changes Told

Personnel and plant changes related to technical sales and service to industrial adhesive customers have been announced by H. B. Fuller Co., St. Paul, Minn. The company has opened a new glue processing and manufacturing unit in Detroit, Mich., and Richard Coleman has been named resident manager. Mr. Coleman will also continue as sales representative for the Michigan territory. James O'Leary, who was formerly head chemist with the company at Cincinnati, Ohio, has been appointed head of technical service for the Detroit area.

T. H. Sires has been named to the Nebraska territory succeeding Tony Andersen who has been assigned to the New York City area. Mr. Andersen reports to the Linden, N.J., plant and Mr. Sires is responsible to the Kansas City, Kans., branch. Nulan Terry has also joined the Kansas City plant sales staff and is assigned to the South Texas region, with headquarters at Houston. Richard Bohart has been appointed sales representative for the Pittsburgh area, transferring from Tampa, Fla., and will be located in Buffalo, N.Y. Named to succeed Mr. Bohart as the Tampa area sales representative is Robert Odum.

Enter Polymer Venture

U B S Chemical Co., Cambridge, Mass., and Permutit Co. Ltd., London, England will join to produce and distribute Ubatol brand polymer emulsions. The synthetic polymer products will be produced at the Permutit chemical works in Ponty Clun, Glamorgan, South Wales, for distribution to the floor polish industry throughout the United Kingdom and Europe. U B S has developed a full line of emulsions under its Ubatol trademark during the past seven years, and Permutit will share its manufacturing capabilities with U B S when facilities now being erected begin polymer emulsion production.

Kleen-Stik Wins Award

The dispenser package produced by Kleen-Products, Inc., Chicago, Ill., for its new Two-Sided Adhesive in Tape Form received a plaque, one of three awards for Best Packaging Design, at the Art Material Trade Show held recently at the Edgewater Beach Hotel in Chicago, Ill. The package houses a new pressure-sensitive, two-sided adhesive that is carried on a release-coated carrier strip. The adhesive is rolled on a 3-inch cor

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Bostik Adhesive	Principal use*	Characteristics*
258	Fabric to Rubber	Fast break — Quick grab
S28-72	General Purpose Latex Leather to Leather — Paper etc.	High tack — Quick grab
601	Polyethylene to itself Paper and Foil	Low adhesion — High tack
1007	Metal primer	Excellent adhesion to metals
1008 A&B	Primer for rigid plastics Neoprene to primed surfaces Neoprene to itself	High tack
1024 A&B	Neoprene to itself Neoprene to primed surfaces	Good heat resistance
1125 A&B	Neoprene to Neoprene	MIL-C-5540 Long-lasting band, long working period
1142	Neoprene inflatables General purpose Neoprene to itself and to Metal	MIL-A-1154B Excellent bonds
2003 A&B	Natural rubber to itself	MIL-C-5539 Long-lasting bond
2022	Paper to Paper	Excellent tack — Advertising layouts
2032 A&B	Leather to rubber	Excellent adhesion — good tack
2102	Pressure sensitive	High solids — High tack-knife coat
2293	Wallboard and hardboard to concrete and dry wall construction	One way, excellent bond
3035	General purpose	Permanent bond to many surfaces, including metals
4025	Butyral fabric to itself Saran to itself and metals	Short tack, excellent adhesion
4034	General purpose	MIL-C-4003 Good oil resistance
4040	Vinyl to vinyl and other materials.	Good aging, resistance to discoloration — Long tack
4500	Metal to Wood	One way heat activation
4585	General purpose	Good oil, water and detergent resistance
7008	Metal to Metals Metal to plastics Metal to Rigid paper	Reactivation by heat used extensively in electronics for speakers
7026	Metal to Metals Metal to plastics Ceramics to other materials	Used to bond rigid plastics to metal with heat and pressure
7028 A&B	Metal primer	Adheres various rubbers to metal without tie cements, heat and pressure required.
1178	Seam Sealant	Neoprene, black
1179	Seam Sealant	Neoprene, clear
7058	Seam Sealant	Vinyl affinity — Good light stability — clear in color
4777-81	Pressure sensitive coating	Clear in color. Good tack applied by roller coater

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New Urethane Company

The newly-founded company CPR International Corp. (Chemicals Plastics Research), Los Angeles, Calif., has announced that it will make available a capacity of over 500,000 pounds per day of urethane polyester base, to be supplemented by manufacture of other urethane chemicals and formulations, once the company's plant in Torrance, Calif., is completed. The company is engaged in research and development in the field of chemistry with emphasis on urethanes and production of urethanes. A complete line of fabricated products and formulations for the aircraft, missile, marine, heating, air conditioning, packaging, construction and furniture industries also will be produced at the new site. Included are rigid and semi-rigid urethane foams, rigid and semi-rigid solid urethanes, urethane elastomers and coatings, sealants and electrical potting compounds.

Fills Marbon Post

Earl W. Scott has been appointed to the post of market development manager for latex and coatings by Marbon Chemical, Washington, West Va. The position, a new one, was created to handle the growing market activities with new products developed for the latex and coatings industries.

Mr. Scott is a graduate of the University of Wisconsin. His background includes more than 16 years in the polymer and coating field, and he was formerly associated with Goodyear Tire and Rubber Co., Burlington Mills, and General Electric. His experience includes work with all phases of the development and utilization of coating products. Prior to his new assignment, Mr. Scott was the development coordinator for latex and coatings.

Goodyear Resin Coatings

A new line of polyester resin-based coatings, to be marketed under the tradename Vitel, has been developed by the Chemical Division of Goodyear Tire and Rubber Co., Akron, Ohio. According to Goodyear, the coatings have exceptional resistance to abrasion, ultraviolet rays, chemicals and weather, and show promise for application as clear, tinted or color coatings for metals as well as for protective and decorative coatings for architectural aluminum and aluminum foil and in wood stains, toners, primers and finishes.

Robert J. Leander

New Mystik President

Robert J. Leander has been elected president of Mystik Adhesive Products, Inc., Chicago, Ill., succeeding Russell J. Leander, company founder, who has been elected chairman of the board. Robert D. Smith has been named executive vice-president. Mr. Leander has been president of Chicago Show Printing Co., and will continue as chairman of this company.

Allen Announces Plastic

Development of Alplex Liquid Casting Plastic, an inexpensive liquid plastic for making durable castings in rubber or plaster molds, has been announced by Allen Plastics Corp., New York, N.Y. According to the manufacturer, coloring can be added to Alplex, and the product is also waterproof and weather-resistant. Shells or solid objects can be cast with Alplex by adding a curing agent, mixing and pouring into rubber, plaster or metal molds. As the product is 100 per cent solids, there is practically no shrinkage, and the cast object can be removed from the mold within ten to twenty minutes, without heating or cooling.

Polymer Addition Built

Polymer Industries Inc., Springdale, Conn., has completed and dedicated an expansion of its Springdale, Conn., plant for the production of industrial adhesives and textile specialty polymers. The $1 million expansion includes a new general office area, a tank farm, a solvent-mixing plant, a polymerization plant and a 100 per cent increase over former production and laboratory areas.

Riegel Considers Merger

Stockholders of Riegel Paper Corp., New York, N.Y., were to have voted October 21 on proposed mergers of Bloomer Bros. Co., Lassiter Corp., Fairtex Corp., and Branson Yarn Co. into Riegel. Upon approval Riegel was to issue a total of 278,843 shares of common stock in exchange for all of the common stock of the other companies. Based on current operations, the mergers will add about $19 millon in annual sales to Riegel's volume. Bloomer Bros., Newark, N.Y. is a carton manufacturer and converter, mainly in the ice cream and egg packaging fields; Lassiter Corp., Charlotte, N.C., is a converter of packaging films, also manufacturing cartons, labels and laminates; Fairtex and Branson, both in Charlotte, N.C., manufacture metallic yarns and chips for automotive upholstery, fabrics, floor coverings, and plastics.

Isochem Names Abraham

Joseph W. Abraham has been appointed technical director at Isochem Resins Co., Providence, R.I., with responsibility for research and development work relative to the company's line of epoxy resin formulations and allied products. Mr. Abraham is a chemical engineer; he holds a B.A. degree from Providence College, and has done graduate work at the University of Massachusetts. He has held technical positions with U.S. Rubber Co., at Providence, and International Minerals and Chemicals Corp., Mulberry, Fla. He was most recently employed as an organic coatings chemist at Chemical Products, Inc., East Providence, R.I.

Anchor Names Bederson

Irving Bederson, who has over 20 years experience in the adhesive industry, has been appointed sales manager of Anchor Adhesives Corp., Flushing, N.Y. He has been associated with the company since it was formed in 1951. Anchor expansion plans call for additions to the sales force and diversification into other industries.

Enjay Completes Unit

The Enjay Chemical Co., New York, N.Y., has completed facilities for the production of over 100 million pounds of acetone annually at its Bayway Refinery, Linden, N.J. The acetone is produced through the catalytic dehydrogenation of isopropyl alcohol.

Avery Label Opens Cleveland Plant

What is said to be one of the largest pressure-sensitive label manufacturing plants in the United States was recently dedicated by the Avery Label Co. in the new industrial park section near the Cleveland Municipal Airport, as the first step in its Silver Anniversary expansion program. Koder M. Collison, director of the Department of Industrial and Economic Development, representing Michael V. DiSalle, governor of Ohio, was a principal speaker at the dedication ceremonies. Mr. Collison cited "the importance of the pressure-sensitive labeling industry," adding:

"In our discussion concerning the celebration of the Silver Anniversary of Avery Adhesive Products, Inc., Governor DiSalle commented on the progress made by this particular industry and on the courage and foresight of Mr. R. Stanton Avery, who actually fathered a new form of industry in the trying days of the depression. Certainly, the growth of the industry is a tribute to its founder, Mr. Avery."

These same sentiments were sent by Senator Frank J. Lausche, in a message noting the company's Silver Anniversary. The Ohio Senator pointed to the fact that the pioneer pressure-sensitive label industry "has grown from an idea and a mere infant" to an important organization, contributing to the economic well-being of the nation.

Opening Second Plant

The pressure-sensitive label manufacturer is soon to open a second plant in North Brunswick, N. J., greatly expanding its East Coast facilities, which were first established during 1956.

The new Ohio plant, which will draw its personnel from the Cleveland area, establishes a source of supply for Avery customers throughout the midwest within a day's shipping time from their own backyards, according to John S. Torrey, vice-president and general manager, who added, during the dedication ceremonies:

"Orders for Avery Adhesive labels as well as adhesive decorative trim products, can now be supplied from our new Cleveland plant, greatly adding to the company's capacity to meet the growing demand for self-adhesive products in industries as diverse as missiles and refrigerators and radios."

Dedication of the 18,000-square-foot plant on a five-acre plot marks the beginning of Avery's second quarter century of growth. The company, as well as the pressure-sensitive label industry, was founded during 1935, when R. S. Avery, chairman of the board, invented a series of machines making possible the manufacture of the product.

Hughson Names Alstadt

Donald M. Alstadt has been appointed vice-president of the Hughson Chemical Co., a division of the Lord Manufacturing Co. Hughson produces adhesives and chemical specialties. Mr. Alstadt joined Lord in 1943 and has served as manager of Hughson since its formation in 1959. During the past four years he also has acted as manager of central research for Lord, a position which he now relinquishes. Mr. Alstadt graduated from the University of Pittsburgh in 1947 with a B.S. degree in chemistry. He has served as a consultant to the Carborundum Co. and Transistor Products Co. He is a Fellow of the American Institute of Chemists and a member of the American Physical Society, American Chemical Society, Faraday Society of England and Electrochemical Society.

Dow Charges Stauffer

Dow Chemical Co. has filed an infringement of patent suit against Stauffer Chemical in U.S. District Court in Wilmington, Del., charging Stauffer with infringing patented processes for making perchloroethylene and carbon tetrachloride. Dow has cited its U.S. Patents 2,442,324, 2,577,388, and 2,727,076 in seeking an injunction against further infringement, and has asked the court to order an accounting for profits.

ADM Breaks Ground

Archer-Daniels-Midland Co., Minneapolis, Minn., has broken ground for a new chemical center near Peoria, Ill. Scheduled to be operating by the spring of 1962, the plant will manufacture nitrogen compounds, plasticizers and intermediate chemicals. The unit is expected to cost about $15 million.

Slates British Plant

Cyanamid of Great Britian, Ltd. has announced plans to construct a £430,000 melamine plant, to have a capacity of 6 million pounds per year. It is scheduled for completion by early next year. Melamine is used in the production of plastic laminates and molding compounds.

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For additional information on Lefkoweld Super-Strength Epoxy Adhesives, fill in the coupon below, attach to your company letterhead and mail to Leffingwell Chemical Company.

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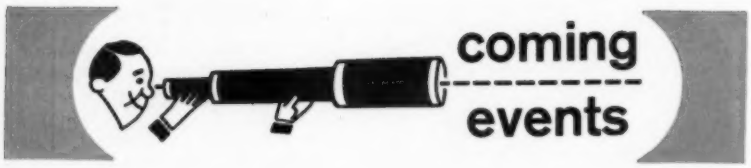

Oct. 30-Nov. 2. Federation of Societies for Paint Technology, 38th Annual Meeting and 25th Paint Industries' Show, Sherman Hotel, Chicago, Ill.

Oct. 31-Nov. 2. Packaging Institute, 22nd Annual National Packaging Forum, Statler Hilton Hotel, New York, N.Y.

Oct. 31-Nov. 4. American Management Association, Packaging Management Course, Hotel Astor, New York, N.Y.

Nov. 1-3. Packaging Association of Canada, 9th Canadian National Packaging Exposition, Automotive Building, Toronto, Ontario, Canada.

Nov. 2-3. American Forest Products Industries, Inc., Annual Meeting, Shoreham Hotel, Washington, D.C.

Nov. 2-6. National Flexible Packaging Association, Fall Meeting, Boca Raton, Fla.

Nov. 6-9. Chemical Institute of Canada, Chemical Engineering Division, 10th Canadian Chemical Engineering Conference, Chateau Frontenac, Quebec City, Quebec, Canada.

Nov. 9-10. Chemical Market Research Association, Annual Meeting, Pittsburgh Hilton Hotel, Pittsburgh, Penna.

Nov. 14. Salesmen's Association of the American Chemical Industry Annual Sales Clinic, Roosevelt Hotel, New York, N.Y.

Nov. 15-17. Building Research Institute, Fall Conferences, Shoreham Hotel, Washington, D.C.

Nov. 16-18. Roll Label Manufacturers Association, Fall-Winter Meeting, Desert Inn, Las Vegas, Nev.

Nov. 17. New Products Industrial Symposium, Sponsored by Quantum, Inc., Yankee Silversmith Inn, Wallingford, Conn.

Nov. 22. Manufacturing Chemists' Association, 10th Semi-Annual Meeting and Mid-Year Conference, Statler Hilton Hotel, New York, N.Y.

Nov. 27-Dec. 2. American Society of Mechanical Engineers, Annual Meeting, Statler Hilton Hotel, New York, N.Y.

Nov. 29. New Products Industrial Symposium, Sponsored by Quantum, Inc., Harvard Club, Boston, Mass.

Dec. 1-2. Rubber & Plastic Adhesive & Sealant Manufacturers Council, Winter Meeting, Edgewater Beach Hotel, Chicago, Ill.

Dec. 3-9. Chemical Specialties Manufacturers Association, 47th Annual Meeting, Hollywood Beach Hotel, Hollywood, Fla.

Dec. 4-7. American Institute of Chemical Engineers, Statler Hotel, Washington, D.C.

Dec. 5-8. Third National Conference on the Application of Electrical Insulation, Conrad Hilton Hotel, Chicago, Ill.

Dec. 8. Synthetic Organic Chemical Manufacturers Association, Annual Meeting, Roosevelt Hotel, New York, N.Y.

Dec. 11-14. American Nuclear Society, Mark Hopkins Hotel, San Francisco, Calif.

Dec. 12-15. Industrial Building Exposition and Congress, New York Coliseum, New York, N.Y.

Dec. 26-31. American Association for the Advancement of Science, Annual Meeting, New York, N.Y.

Portrait Of

BORIS POZNIAK

As technical director for Pecora, Inc., Philadelphia, Penna., Boris Pozniak has been responsible for guiding the company's current deevlopment of sealers and adhesives for the building industry.

When he joined Pecora in 1955 it was already prominent in the manufacture of natural polymer sealants and adhesives and undergoing a transition to keep pace with the demands for new and improved materials for curtain wall and other recent developments in the building industry. He sparked the research and development of a broad line of synthetic resin, rubber and inorganic sealants and adhesives.

Mr. Pozniak is a firm believer in the policy of training chemists to have a complete understanding of the field applications of materials developed in the lab. Incidentally, one of his pet projects has been the continued development of polysulfide sealants for the building industry.

Mr. Pozniak attended New York's Hunter College and received his B.A. in chemistry in 1950. Before joining Pecora, he was a research chemist with the Borden Chemical Division and worked on the synthesizing of vinyl and acrylate polymers.

A member of many technical organizations, Mr. Pozniak is now chairman of Task Group 1 of the ASTM Committee C-24 on Joint Sealants. He is also active in several working committees of the Rubber and Plastic, Adhesive and Sealants Manufacturer's Council.

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Wherever possible, CARE starts self-support programs. To boost food production, CARE supplies simple farm tools of steel to replace the ancient forked stick which barely scratches the soil. Carpenters' tools, fishing gear, masonry tools, sewing machines—tools which enable men and women to earn their own livelihood—transform your CARE dollars into the greatest gift one human being can bestow on another: the gift of dignity, born of self-reliance.

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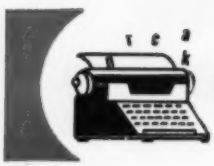


names in the news

George J. Schwartz, formerly vice-president and general manager of the Boston Division of Minneapolis-Honeywell Regulator Co., has been elected president of Compo Shoe Machinery Corp., Waltham, Mass.

Edward W. Bastian, a company vice-president, has been appointed general sales manager of the Catalin Corp. of America, New York, N.Y.

Jack Slatky, formerly vice-president of sales at Sierracin Corp., has joined the sales staff of Coast Pro-Seal and Manufacturing Co., Los Angeles, Calif., as gasketing product manager.

Dr. W. M. Hearon has been appointed vice-president of research and development of Crown Zellerbach Corp., San Francisco, Calif., and **Dr. John S. Barton** has been promoted to the post of director of research in charge of the Central Research Division in Camas, Wash.

Dr. Alan C. Batchelder has been appointed manager of chemical licensing in the Licensing Division of Shell Development Co., located in New York, N.Y.

Dr. W. David Stallcup, formerly director and vice-president of Glidden Co., has been elected president of Nelio Resins, Inc., Jacksonville, Fla.

Robert E. Bennet, formerly with Brunswick Corp., has joined Food Machinery and Chemical Corp., in Baltimore, Md., as a plastics engineer.

Charles A. Dorff has been named chief chemist in the Specialty Sales Laboratory of Nopco Chemical Co., Inc., at Newark, N.J.

Dr. Donald M. Beeson has joined the Chemicals Research Division of Esso Research and Engineering.

William Hans has been appointed a sales representative for Armour Industrial Chemical, for Western Canada, and will be located in Calgary, Alberta.

Dr. Richard J. Lee has joined the Adhesive, Resin, and Chemical Division of American-Marietta Co., Seattle, Wash., as manager of the Polymer Section of the Research Department.

Dr. Carl F. Prutton, a director of Food Machinery and Chemical Corp., has been elected to the board of directors of Commercial Solvents Corp., New York, N. Y.

Eger V. Murphree, president of Esso Research and Engineering, has been appointed general chairman of the 127th annual meeting of the American Association for the Advancement of Science.

Robert O. Wilson, formerly with Archer-Daniels-Midland Co., has joined Thomas J. Lipton, Inc., Hoboken, N. J., as a senior chemical engineer.

Dr. Harry A. Wistrich has been appointed a supervisor in the Chemical Separation Department of Shell Development, Co., Emeryville, Calif.

Richard S. Goldman has joined A. E. Staley Manufacturing Co., Decatur, Ill., as a technical sales trainee in the Chemical Department.

Fred Isley has been appointed public relations director of United States Plywood Corp., New York, N. Y.

Fred T. Kottenstette, formerly with the company's Houston, Texas, office, has been named group leader of sales development of Texas Butadiene and Chemicals, in New York, N. Y.

Dr. Nobuyuki Nakajima has joined the Analytical and Physical Research Department of the Research Division of W. R. Grace and Co., in Clarksville, Md., and **Dr. Owen York, Jr.,** has joined the Organic Research Department.

William R. Daragan has been named technical service representative in the Chlor-Alkali Division of Food Machinery and Chemical Corp., New York, N.Y.

Philip D. Caine has been promoted to the post of sales promotion manager of Becco Chemical Division of Food Machinery and Chemical Corp., New York, N.Y.

Dr. Warren A. Thaler has joined the central basic research laboratory of Esso Research and Engineering, at Linden, N.J.

Robert P. Dames has been named to the New York office of fatty acid sales for Emery Industries Inc., Cincinnati, Ohio.

William J. Miller, formerly director of the International Division of Mystik Adhesive Products, Inc., has been elected vice-president of Mystik A.G. of Zug, Switzerland.

John A. Reichle has been named representative in the St. Louis area for the Mid-States Gummed Paper Division of Minnesota Mining and Manufacturing Co., St. Paul, Minn.

A. H. Batchelder has been elected chairman-elect of the board of trustees of Gordon Research Conferences, succeeding **Dr. Robert W. Cairns** who is now chairman of the board of trustees.

Henry L. Ford has been elected president of Eastman Chemical Products, Inc., Kingsport, Tenn., succeeding **Dr. L. K. Eilers,** who has become vice-chairman of the board of directors.

Howard M. Smith has been named to head the new laboratory of National Starch and Chemical Corp., in Atlanta, Ga.

Richard H. Freyer has been named manager of testing laboratories at the Chamberlain Laboratories, research and development center of U.S. Stoneware, Akron, Ohio, and **Alan Corry** has joined the staff as a research engineer.

Earl W. Scott has been appointed to the new post of market development manager of latex and coatings at the Marbon Chemical Division of Borg-Warner Corp., Washington, West Va.

Dr. Milton E. Fuller, formerly with Shell Development, has joined the plastics laboratory of International Business Machines Corp., Poughkeepsie, N. Y., as a staff chemist.

Eugene Holman, former chairman of the board of Standard Oil Co. of New Jersey, has been named a director of the Borden Co., New York, N.Y.

Two New Adhesives

Development of two new adhesives which offer exceptional adhesion to plastic has been announced by the Adhesive Products Corp., New York, N.Y. The adhesives, which are made from a new latex polymer recently developed by Adhesive Products Corp., are designated "Plastix Wet Stick" and "Plastix Heat Seal," and are said to be excellent for adhering unsupported plastic to cotton, wood, leather, acetate, mylar, paper, foam rubber, polyurethane foam and other materials. Plastix Wet Stick and Heat Seal Adhesives are easily applied by roller coater, spray or brush and are also available in heavier viscosities for doctor blade application. Plastix Adhesives dry rapidly to form transparent, tack-free surfaces that do not have a tendency to discolor materials. Although they are water-based, Plastix Adhesives weld to plastics with an exceptionally strong bond which resists both washing and dry cleaning.

Plastix Wet Stick is excellent for flocking on vinyl and other plastics and can be used on thin gauge plastics without wrinkling. Plastix Heat Seal is ideal for attaching appliques and decorative ornaments to sweaters, curtains, toys, belts, handbags, etc. Materials can be precoated with Plastix Heat Seal, allowed to dry, and stacked or die cut for heat-sealing immediately or at a later date. A strong, permanently-flexible bond to almost any surface is formed instantaneously when heat is applied. Plastix Adhesives are available in 55-gallon drums and in one- and five-gallon containers.

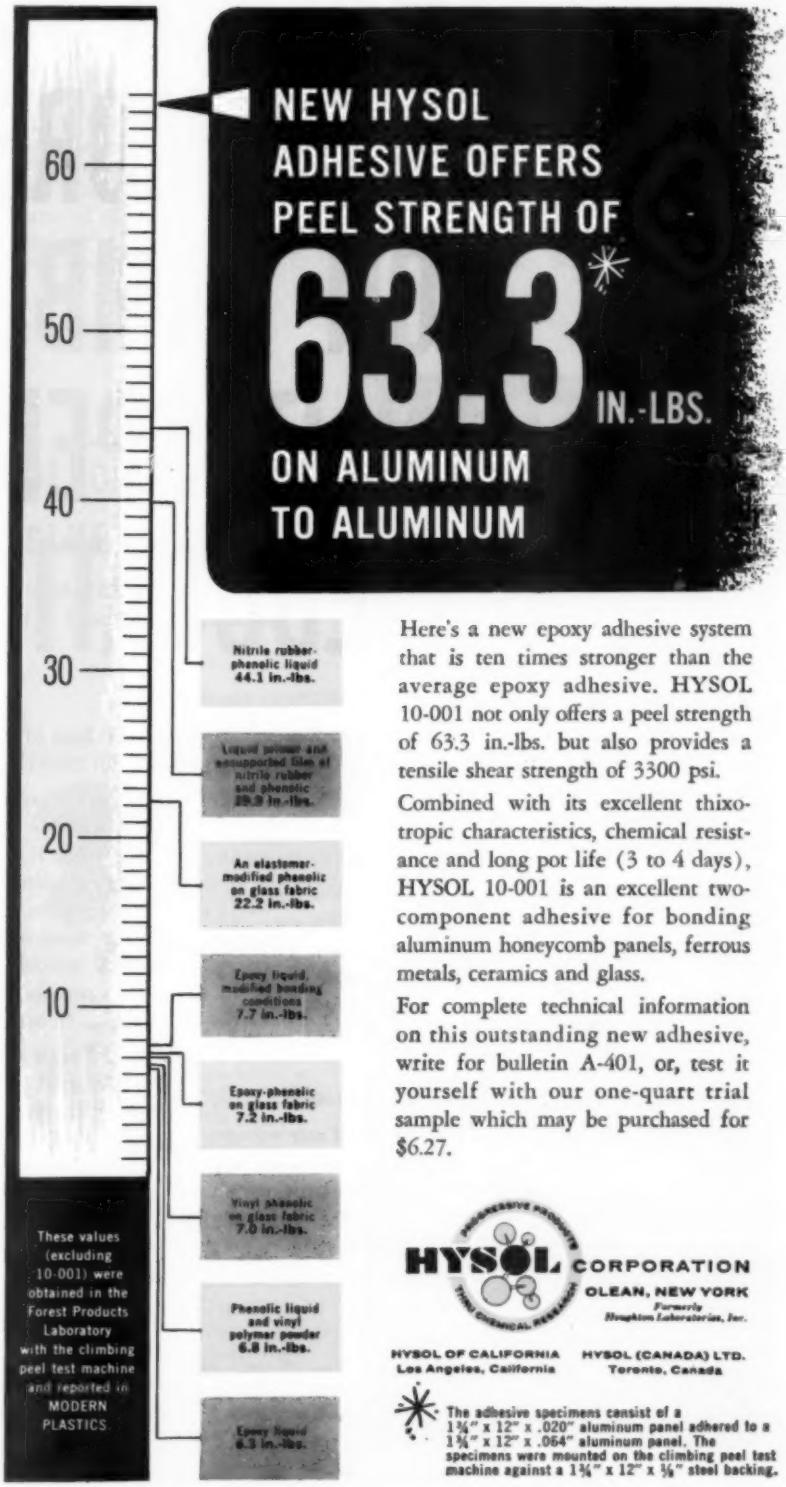
Colton Transfers Rauh

Edward Rauh, sales representative for Colton Chemical Co. in Ohio, Michigan and Indiana has been transferred to California. Mr. Rauh will be assigned to the Los Angeles office. Colton Chemical Co., a division of Air Reduction Co., Inc., is headquartered in Cleveland, Ohio.

Named by Staley

Eldred K. Olson has been named chief chemist of the quality control laboratory of the A. E. Staley Manufacturing Co., Decatur, Ill., succeeding Lisle R. Brown who has retired. A graduate of the University of Iowa with a B.S. and M.A. degree in chemistry, Mr. Olson joined Staley as an analytical chemist in 1938. He has been a senior analytical chemist in the Staley control laboratory since 1955.

. . . and they said this couldn't be done!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NEW HYSOL ADHESIVE OFFERS PEEL STRENGTH OF
63.3 IN.-LBS.
ON ALUMINUM TO ALUMINUM
Nitrile rubber-phenolic liquid 44.1 in.-lbs.
Liquid primer and unsupported film of nitrile rubber and phenolic 29.9 in.-lbs.
An elastomer-modified phenolic on glass fabric 22.2 in.-lbs.
Epoxy liquid, modified bonding conditions 7.7 in.-lbs.
Epoxy-phenolic on glass fabric 7.2 in.-lbs.
Vinyl phenolic on glass fabric 7.0 in.-lbs.
Phenolic liquid and vinyl polymer powder 6.8 in.-lbs.
Epoxy liquid 6.3 in.-lbs.
These values (excluding 10-001) were obtained in the Forest Products Laboratory with the climbing peel test machine and reported in MODERN PLASTICS.

Here's a new epoxy adhesive system that is ten times stronger than the average epoxy adhesive. HYSOL 10-001 not only offers a peel strength of 63.3 in.-lbs. but also provides a tensile shear strength of 3300 psi.

Combined with its excellent thixotropic characteristics, chemical resistance and long pot life (3 to 4 days), HYSOL 10-001 is an excellent two-component adhesive for bonding aluminum honeycomb panels, ferrous metals, ceramics and glass.

For complete technical information on this outstanding new adhesive, write for bulletin A-401, or, test it yourself with our one-quart trial sample which may be purchased for $6.27.

HYSOL CORPORATION
OLEAN, NEW YORK
Formerly Houghton Laboratories, Inc.

HYSOL OF CALIFORNIA
Los Angeles, California

HYSOL (CANADA) LTD.
Toronto, Canada

* The adhesive specimens consist of a 1¾" x 12" x .020" aluminum panel adhered to a 1¾" x 12" x .064" aluminum panel. The specimens were mounted on the climbing peel test machine against a 1¾" x 12" x ⅛" steel backing.

WHAT HAPPENS WHEN A NATION SPENDS MORE ON GAMBLING THAN IT SPENDS FOR HIGHER EDUCATION?

If you can find any Romans around, ask them. They lived pretty high on the hog in their day. That is, until some serious-minded neighbors from up North moved in. The rest is ancient history.

You'd think their fate would have taught us a lesson.

Yet today we Americans spend twenty billion dollars a year for legalized gambling, while we spend a niggardly four-and-a-half billion for higher education. Think of it! Over four times as much! We also spend six-and-a-half billion dollars a year for tobacco, nine billion dollars for alcoholic beverages, and billions more on other non-essentials.

Can't we read the handwriting on the wall?

Our very survival depends on the ability of our colleges and universities to continue to turn out thinking men and women. Yet today many of these fine institutions are hard put to make ends meet. Faculty salaries, generally, are so low that qualified teachers are leaving the campus in alarming numbers for better-paying jobs elsewhere.

In the face of this frightening trend, experts estimate that by 1970 college applications will have doubled.

If we are to keep our place among the leading nations of the world, we must do something about this grim situation before it is too late. The tuition usually paid by a college student covers less than half the actual cost of his education. The balance must somehow be made up by the institution. To meet this deficit even the most heavily endowed colleges and universities have to depend upon the generosity of alumni and public spirited citizens. In other words, they depend upon *you*.

For the sake of our country and our children, won't you do your part? Support the college of your choice *today*. Help it to prepare to meet the challenge of tomorrow. The rewards will be greater than you think.

It's important for you to know what the impending college crisis means to you. Write for a free booklet to HIGHER EDUCATION, Box 36, Times Square Station, New York 36, New York.

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AUMA Adopts New Undercoating Specs

A new set of specifications for solvent type automobile undercoating material has been adopted by the Automotive Undercoating Manufacturers Association, Pleasant Ridge, Mich. The purpose of these specifications, according to the AUMA spokesman, is to establish a uniform, high quality standard for automotive undercoatings that will enable distributors, applicators and car owners to select and identify car undercoatings from which maximum satisfaction and service can be expected.

This new set of specifications covers the requirements of solvent type undercoating material in regard to composition, solids content, flash point, storage stability, consistency, application, sound deadening properties, cold temperature adhesion, abrasion and corrosion protection, and resistance to flow at high temperatures, fire, acids and alkali. The specifications also include testing procedures for determining these undercoating requirements.

All undercoating manufacturers are being invited by AUMA to submit their products to testing laboratories which will test their products for conformance to these specifications. Those whose products conform, and who wish to participate in this program, will be authorized to identify their products with an AUMA "Seal of Quality" emblem. Both members and non-members of AUMA are entitled to use the emblem on each product that meets the new set of specifications, and to display it in advertising, sales brochures, and letterheads.

AUMA members and responsible dealers and applicators throughout the country agree that this program of making it possible to identify quality undercoatings is a worthwhile step toward restoring customer confidence and acceptance of this important product in the automotive service field.

Flexible Epoxy Resin

Development quantities of a new flexible epoxy resin are now available from CIBA Products Corp., Fair Lawn, N.J. The new resin, designated Araldite DP-437, is recommended as a modifier for conventional liquid epoxies to produce flexible systems. The product can be mixed in all proportions giving the user a wide range of cured properties. According to the manufacturer, the new resin is suitable for use in adhesives, caulking and sealing compounds, electrical potting, high-solids coatings, impregnating and other applications. Experimental samples and further information on the new resin can be obtained by writing CIBA Products, Fair Lawn, N.J.

FMC Names Three

Food Machinery and Chemical Corp. has named Eric Rau, Charles B. Hopkins, Jr., and John F. Jones, Jr., to the Central Research Department at its Chemical Research and Development Center at Princeton, N.J. Dr. Rau will be working in the area of electrochemistry; Dr. Jones and Mr. Hopkins will be concerned with the FMCoke project. Dr. Rau obtained his doctorate in physical chemistry from New York University. He was associated with Westinghouse Electric Corp. as senior engineer before joining FMC. He is a member of the American Chemical Society and the Electro-Chemical Society.

Dr. Jones was formerly process engineer with Esso Research and Engineering Co. He received his doctorate in chemical engineering from the University of Colorado where he held a research assistantship. He belongs to the American Chemical Society and the American Institute of Chemical Engineers.

Before joining FMC, Mr. Hopkins was a senior research engineer with Cities Service Research.

BLACK BROTHERS GLUE SPREADERS

Complete Range of Sizes and Types for Fast, Economical, Accurate Gluing

No. 22-D HOODED GLUE SPREADER — The modified 22-D glue spreader is arranged to successfully apply contact cements and adhesives containing volatile solvents. 8' through 122" capacities in 6' increments. *Bulletin 11-A, Part 5.*

No. 22-D GLUE SPREADER — For resins, caseins, polyvinyls, protein and similar adhesives; 39 sizes in four models; 8' through 122" capacities in 6' increments. Proven the finest spreader available for the purpose. *Bulletin 11-A, Part 4.*

No. 2-8' BENCH-TYPE GLUE SPREADER — For light edge gluing and similar operations. Roll is 4' diam. x 8' long. *Bulletin 11-A, Part 1.*

No. 567 GLUE SPREADER — Floor type, power-driven, hand feed roll glue spreader for edge gluing and similar operations. 12', 18' and 24' roll widths with 8½' diam. rolls. *Bulletin 11-A, Part 2.*

VERTICAL GLUE SPREADER — Especially designed to speed edge-gluing; eliminates need to turn stock 90 deg. after it comes out of sizing machine. Glues stock up to 4" thick.

"BOBTAIL" 22-D GLUE SPREADER — For efficient application of resin glues, equally adaptable for other cold glues. Ideal for edge gluing lumber stock or other applications which require bottom coating only. *Bulletin 11-A, Part 2.*

You'll never know how fast, accurate and clean a gluing operation can be 'til you put a Black Brothers glue spreader to work in your glue room. Black's complete line of economical high production glue spreaders contains models for practically every type of adhesive, stock and gluing operation: Single and double glue spreaders from 8" to 122" capacity — vertical, hopper-fed, conveyorized, etc. Models, from our bench-type spreaders for laboratory or light production work — to our No. 22-D Super Series for extremely heavy duty operations. Of course, every Black's spreader has the extra-value features which have made them the leading name in gluing equipment throughout the world. Get full details today by writing for product bulletins.

Complete line of gluing, clamping, laminating and roller coating equipment — Since 1882

THE BLACK BROTHERS CO., INC.

patent review

By MELVIN NORD

Apparatus for Gelatinization of Starch

U.S. Patent 2,940,876, issued June 14, 1960 to Norman E. Elsas provides an apparatus for the cooking or gelatinization of starch.

The apparatus is shown in Figures 1 and 2. In operation, the pump (2) is started to force raw starch slurry through the conduit (15) under control of the valve (10) and pressure regulator (18) to the jet mixer (16) and to establish the proper flow of starch through the jet mixer. Thereafter, steam is admitted through the conduit (30) under control of the valve (34) and pressure regulator (32), the solenoid valve (66) being open, to enter the opposite side of the jet mixer and to combine with the starch slurry passing through it.

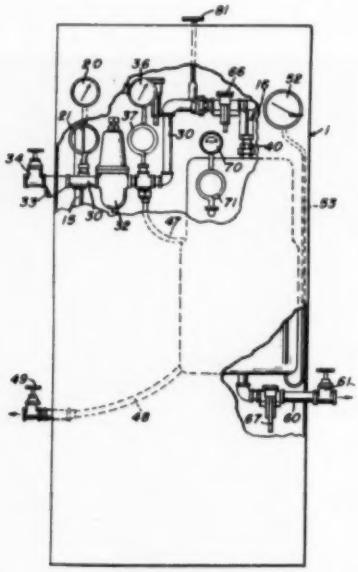

Figure 1

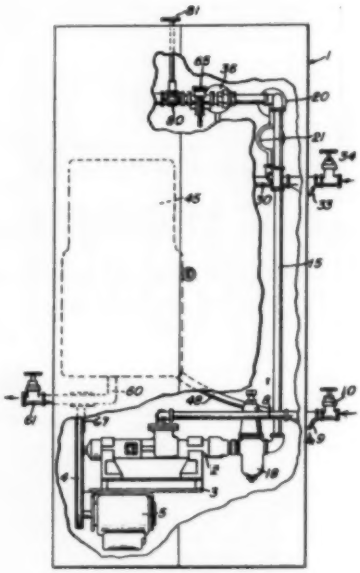

Figure 2

The raw starch granules when blended with steam in the jet mixer are quickly raised to cooking temperatures and gelatinization is effected together with particle disintegration as the material is being projected from the mixer into the pressure tank (45), the solenoid valve in the discharge conduit being closed. The mixing and blending continues until the predetermined pressure within the tank is reached, thus providing an interval for additional homogenization of the cooked starch, whereupon the valve (67) opens to permit discharge of the cooked starch from the tank assuming the valve (61) is open. If there is no immediate demand for the cooked starch and the valve (61) is closed, maintenance of pressure on the tank (45) will cause valves 65 and 66 to close, halting material feed to the mixing chamber (16).

Thermoplastic Rod Adhesives

U.S. Patent 2,940,888, issued June 14, 1960 to Eric C. Johnson and assigned to B. B. Chemical Co., provides a method of bonding a metal work surface to another surface by means of a rod adhesive.

The rod adhesive consists of a heat softenable intimate mixture of 10-30 per cent by weight of an epoxy resinous glycidal polyether containing terminal epoxy groups, and 70-90 per cent by weight of heat softenable resinous material containing polyethylene as a major component. The resin is incompatible in the fluid condition and nonreactive with the epoxy resinous glycidal polyether. The rod is dry and sufficiently stiff to be fed longitudinally for use as needed to supply adhesive material.

The forward portion of the rod is advanced into an elongated heating zone, to soften the end of the rod. Fluid adhesive is transferred from the heating zone to the work surface while still in intimately mixed condition. The other surface is then pressed against the adhesive on the work surface.

Dextran-Sulfite Liquor Solids Adhesive

U. S. Patent 2,933,405, issued April 19, 1960 to Everett E. Witland and Frederick W. Holt, Jr., assigned to The Commonwealth Engineering Co. of Ohio, discloses a dry powder adhesive composition adapted to be mixed with water to provide an aqueous adhesive solution.

The dry composition consists essentially of 5 per cent of a plasticizer (glycerine or sorbitol), 50 per cent of waste sulfite liquor solids (constituting 90-95 per cent of waste sulfite liquor), and 5-10 per cent of dextran (of the Leuconostoc mesenteroides strain and designated NRRL B-512, and having 86-97 per cent of the glucoside linkages in the 1, 6 position and having a molecular weight between 20,000 and that of native unhydrolyzed dextran).

This composition provides a water-resistant tough adhesive.

Adhesive for Corrugated Board

U. S. Patent 2,935,484, issued May 3, 1960 to Lawrence F. Arnold and John F. Jones, assigned to The B. F. Goodrich Co., provides a one-package dry mix adhesive mixture containing uncooked starch, for use in the manufacture of corrugated paper board and paper bags. It is converted to an adhesive simply by stirring into water or aqueous alkali. The adhesive is stable at pH levels sufficient to rapidly gelatinize the uncooked starch, and can thus be employed at high laminating or sealing speeds.

The mixture contains uncooked

starch (preferably finely divided and of the type known as "pearl" starch), an insoluble polycarboxylic acid anhydride tripolymer suspending agent *e.g.*, the tripolymer of meleic anhydride, if necessary an alkali-soluble carboxylic acid polymer, *e.g.*, an alkali salt of hydrolyzed polyacrylonitrile, and if desired, a finely divided solid thermosetting resin. These materials are merely blended to form the dry mix.

Treating Sodium Silicate to Produce a Silica Sol

U. S. Patent 2,935,482, issued May 3, 1960 to Mitchell H. Cubberley and assigned to Wallace & Tiernan Inc., provides a method and apparatus for producing an aqueous product that is useful as a coagulation aid, and that may be described as a silica sol. The product is prepared by the reaction of chlorine solution with sodium silicate in aqueous solution.

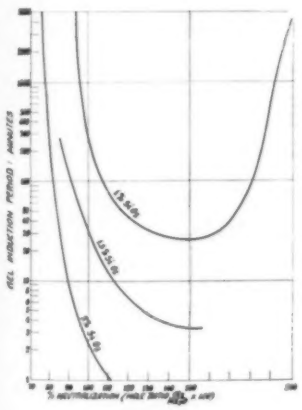

Figure 3

The aqueous silica material immediately resulting from reaction of chlorine and sodium silicate in an aqueous medium, is in the state of a so-called sol, and may be regarded as a transition product hovering somewhere between the original state of solution and the final state of gelation. The period of transition starts with the introduction, for example, of chlorine into the silicate solution and ends, for practical purposes, when the product is gelled to the point where it can no longer be handled as a liquid.

This transition period comprises an appreciable length of the time and is conveniently defined as the gel induction period. For optimum utility, *e.g.*, as a coagulation aid to promote coagulation and setting of solid particles in water to be treated, the sol should be employed at some point in the gel induction period; that is to say, there should be some aging, so to speak, of the chlorine and silicate mixture, yet the transition should not have progressed to the point of complete gelation where the material will not flow freely like a liquid.

Figure 3 shows the effect on gel induction period of mole ratio (Cl_2/Na_2O) for given SiO_2 concentrations in the reaction mixture.

Copies of any patents, including those described here, are available from the Commissioner of Patents, Washington 25, D. C., for 25 cents each. Do not send stamps.

Adhesives manufacturers using HYDROCARBON SOLVENTS, whose plants are located within the shaded areas on this map have access to outstanding products and service by APCO—pioneers in the manufacture of specialty solvents to meet exacting requirements.

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- PETROLENE
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- APV-BENZOL
- APV-TOLUOL
- APV-XYLOL
- APV-20
- APV-50

For information on these and other available solvents WRITE—

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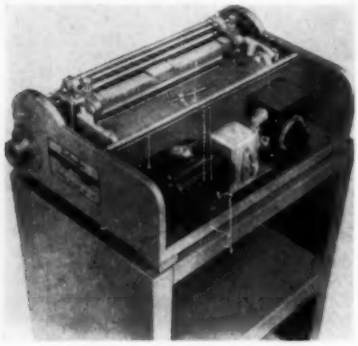
new equipment

Wax Proof Coater

The 12-inch Schaefer Adhesive Wax Proof Coater is designed for use in photocomposition and a variety of commercial printing and graphic arts purposes. The coater, according to the manufacturer,



makes for faster and simpler paste-up composition with neater, more effective results than possible by rubber cement or other means. Any shape of sheet from ¼ inch to 11¾ inches wide and to any length, can be uniformly coated by placing the sheet in the proof coater, which coats one side with hot adhesive wax. The wax-coated sheets can be used immediately for paste-ups in photocomposition and similar operations. The special adhesive waxes used are clear and when applied to acetate sheets do not throw shadows to affect the photography. The complete unit comes supplied with motor, electric heater and thermostat. *American Type Founders Co., Inc.* **E-240**

Resin Dispenser

The greater range of resin-hardener ratios provided by the Model 395 Variable Ratio Resin Dispenser is said to provide greater flexibility in metering two-component liquid resin systems. By means of a simple lever adjustment, the ratio of resin to hardener can be varied from 20:1 to 1:1. The unit is equipped with drip-proof outlet valves. It is available in both hand-operated and motor-driven models. *Delsen Corp.* **E-241**

Epoxy Mixer-Dispenser

Called the Multi-Rez-Processor, the unit is said to simplify the use of two part epoxy and polyurethane compounds. It will proportion, dispense, and mix multi-component reactive resins. Proportional accuracy of the two component media dispensed is maintained through mechanical linkage operating positive

displacement pumps. Thorough blending of the resin mix is accomplished by a powerful motorized mixer. A Teflon impeller is the only part of the Multi-Rez-Processor which enters the reactive resin mix. Short pot-life resin mixes can be handled with ease and safety, the manufacturer states. *CPM Special Machinery Corp.* **E-242**

Precision Force Gage

The new DT series force indicator is designed for measuring tension in a permanent test set-up. The gage has a free-floating transmission rod which is threaded at its end for mounting in test apparatus or fixtures. This rod transmits the tension load to a dial indicator. The DT force gages are available in capacities of 20, 50, 75, 100, 150, 200, and 500 pounds. The gage is able to hold the maximum dial reading after the load has been removed, making it useful for measuring momentary or transient loads. A control button on the instrument is used as a selection device for setting the type of operation desired—either to follow all load fluctuations or to hold the maximum reading. *Hunter Spring Co.* **E-243**

Automatic Drum Warmer

This new, fully-automatic five gallon drum warmer quickly heats viscous materials and maintains them at the temperature and consistency required for easy removal from drums. The new unit is designed to warm drums containing such heavy duty materials as adhesives, rosin, glue, mastics, tar, asphalt, oil, grease, varnish, paint, and putty. The drum warmer is constructed with a baffled radiation which is said to eliminate hot spots. Additional features include: choice of two thermostatically controlled temperature ranges, 60° to 250°F; or 200° to 550 F; two-inch sheet fiberglass insulation;

aluminum reflector; and wire reinforced flexible asbestos gasket for snug fit around drum. The unit plugs into any 110-120 volt outlet, weighs 22 pounds, and is equipped with handles for easy portability. For maximum safety, the drum warmer is provided with polarized (grounded) plugs, and legs that suspend the unit off the floor or ground. *Harold L. Palmer Co.* **E-244**

Laboratory Hot-Melt Coater

Model LC-100, a coating and laminating machine, has been developed for laboratory use, particularly for experimental work and pilot runs. The machine is driven by a ½ hp motor connected to the gear drive by a variable speed pulley, which can be adjusted from 33 to 100 feet per minute, or higher range if required. For hot melt coatings and laminants, the coating roll, top roll, laminating roll and coating tank are piped for oil heating, and the equalizer and smoothbar are electrically heated and thermostatically controlled. The machine consists of an oil heating unit, a laminating unit,

a drying unit for solvent and aqueous coatings, a wet waxing unit, a rotogravure and pressure roll coating unit, a precision coating unit, second and third coating units, and a reverse coating roll. *Haida Engineering Co.* **E-245**

Portable Tape Dispenser

A new strapping tape dispenser, the Time Saver, is fully portable and lightweight. A simple adjustment

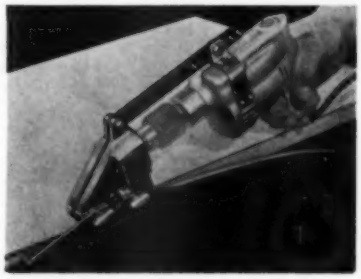
provides the exact tension needed for a good banding job on each application, and a trigger-action cutter enables the user to snip off the exact length of tape needed. *Mystik Adhesive Products, Inc.* **E-246**

Induction Heated Die

The induction heated die has been introduced by the manufacturer because the great increase in the use and production of film and coating has necessitated the development of new techniques and new machines to meet the high temperatures, high speeds and other production requirements. The die provides uniform temperature across the die, an important factor in production of film and coating. The induction heat also improves heat radiation as the insulation on both die and extruder prevents heat loss to the atmosphere. According to the manufacturer, the induction heated die is used extensively on free film, blown film or for coating and laminating. *Hale and Kullgren, Inc.* **E-247**

Plastic-Cutting Shear

The Draco plastic shear can be attached to any ¼ inch electric drill and cuts in straight, curved or circular patterns all plastic laminates and synthetic resin materials such as Formica, Micarta, Pionite, etc. It also cuts and trims a wide variety of other materials including linoleum, hard fibre board, veneers, insulating materials, mica sheets, chalkboard and pressboard. According to the manufacturer, outstanding cutting



performance is assured in cutting materials up to 3/16 inch thickness, with absolutely no chipping, cracking or feathering. The shear weighs only one pound, and the knives and blades, made of special alloyed steel, are designed for 500 hours service before resharpening. *L. E. Birbach Associates, Inc.* **E-248**

FOR MORE INFORMATION on these new products use the Readers Service Card in this issue.

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book reviews

Physical Chemistry of Surfaces. *By Arthur W. Adamson. Published by Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N.Y. 6 x 9¼ in. 629 pp. $12.75.*

It is perhaps worth noting that in reality we always deal with the *interface* between two phases. In general, the properties of an interface are affected by changes in either of the two phases involved. On this note, Dr. Adamson begins a comprehensive and modern physico-chemical treatment of both liquid and solid surfaces, thoroughly grounded in fundamentals and logically developing advanced concepts. Primarily, the book is intended to serve as a first year graduate level text. It is built around a course given for many years at the University of Southern California.

An equally important purpose of the book is to be of service to professional chemists. Surface and colloid chemistry are too often neglected in academic course programs, in spite of their general importance. Practicing chemists will find the book a useful bridge between basic physical chemistry and a proliferating general literature and specialized monographs.

The emphasis is on a coherent and critical development of topics and not on accomplishing a definitive coverage of the enormous literature in the field. Statements are referenced wherever possible, but apart from some references to early work inserted for historical interest, the main intent has been to provide a guide to important contemporary work. This will serve as a point of departure for more detailed reading.

The Story of Chemistry. *By Georg Lockemann. Published by Philosophical Library, Inc., 15 East 40th St., New York, N.Y. 4½ x 7½ in. 277 pp. $4.75.*

The author of this history is one of Germany's leading organic chemists. Both he and a number of his distinguished students have made discoveries that have contributed vitally to the recent growth of the German chemical industry. Since the history of chemistry has been revolutionized by researches of the past fifty years, this book renders may earlier histories obsolete. New light is thrown upon early chemistry in Egypt and its beginnings in Greece, as well as upon Arabic chemistry. Lockemann brings his story up to the latest discoveries of nuclear chemistry, on the borderline with nuclear physics.

Part One discusses the periods of prehistory, alchemy and iatrochemistry through the foundation of independent chemistry by Jungius and Boyle. It ends with the phlogiston theory.

Starting with Lavoisier's oxidation theory, Part Two progresses through the development of quantitative methods, the discovery of new elements, and the role of the three great German chemists: Liebig, Woehler and Bunsen. The rise of industrial organic chemistry is covered, as are theoretical organic, industrial and theoretical inorganic, general chemistry, and physical chemistry. Survey of the twentieth century continues with discussions of radioactivity, artificial elements and the overthrow of previous basic views.

High Speed Testing, Volume I. *By A. G. H. Dietz and Frederick R. Eirich. Published by Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N. Y. 6 x 9¼ in. 112 pp. $5.00.*

High-speed test techniques have become accepted in industry as a very adequate means of characterizing materials and of predicting materials for shock load applications. In Boston in 1958, a symposium brought together people interested in high-speed test methods and data applied in research and development, in material applications, in product engineering, and in quality control. This book reports the proceedings of that meeting, sponsored by the Plas-Tech Equipment Corporation. Dr. Dietz of the Massachusetts Institute of Technology and Dr. Eirich of the Polytechnic Institute of Brooklyn chaired the meeting.

This book is the first of several devoted entirely to high-speed testing. Future volumes will cover instrumentation, equipment, test methods and techniques, interpretation of data, and practical applications of information. The first meeting attempted to include as many classes of materials as practical. Two papers are concerned with plastics, one with solid fuels, one with cushioning materials, two with textiles, and two with metals. It is hoped that future symposia will include paper, rubber, and soils in addition to these materials.

Trade Literature

Adhesives in Product Design. A four-page bulletin especially designed to provide product engineers with up-to-date information on adhesives and the advantages they offer for joining parts. Principal uses and characteristics of representative formulations are grouped in a table. Included are adhesives for bonding metals, rubber, plastics, fabrics, leather, glass, and wood materials to themselves and in combination. A separate section describes in general terms solvent base, water base and hot melt adhesives made by the company. Twelve specific bonding jobs are listed, selected on the basis of their specialty natures or particularly critical functions. Details on the company's complete laboratory and field service plan and how designers can avail themselves of such application assistance complete the bulletin. *B. B. Chemical Co.* L-286

Fortifying Resin Adhesives. Several uniquely stable and versatile organic chemical compounds which are finding new uses in products varying from adhesives to insecticides, specialized lubricants and surface coatings are described in this 43-page booklet entitled "The Aroclor Compounds." The booklet states that adhesive formulators use Aroclor compounds to fortify certain resin adhesives against attack by water, acids, alkalies, and other factors that injure binding properties. The new booklet, in discussing 13 Aroclor products, each representing a series, points out that Aroclor uses include making surface coatings moisture-proof and more durable, prolonging the effectiveness of insecticides by retarding evaporation, and imparting flame retardance and dielectric strength as secondary or extender plasticizers in resin formulations. *Monsanto Chemical Co.* L-287

Resins for Rubber Adhesives. A new, illustrated booklet entitled "Schenectady Resins for Rubber Compounding and Rubber-Based Adhesives." This 16-page publication presents the latest data on the properties and functions of the resins produced by the company for use in compounding rubber and in formulating rubber-based adhesives. These resins include the major types of phenolics, terpene-phenol resins, and pure hydrocarbon polyterpenes. The use of these resins with butyl, natural, neoprene, nitrile, reclaimed and SBR elastomers is discussed. Much of the data, including a concise, two-page summary of the properties, uses, compatibility, and solubility of the resins, is presented in tabular form. *Schenectady Varnish Co., Inc.* L-288

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- **Adhesive Bonding of Reinforced Plastics—H. A. Perry. $8.75.** Survey of the design and assembly of structures and products, particularly glass-fiber-reinforced plastic products, by means of adhesives. Gives data on equipment and methods used to produce adhesive bonded joints. ☐

- **Adhesive Bonding of Metals—G. Epstein. $2.95.** Considers adhesives used with metals, indicating when an adhesive-bonded joint is advantageous; the type adhesive to use; how to use it, and how to design the joint for optimum performance. ☐

- **Epoxy Resins—Their Applications and Technology—H. Lee and K. Neville. $8.00.** Guide to the field of epoxy resins, covering the chemistry of their preparation and applications, including a section on adhesives. ☐

- **Polyamide Resins—Donald E. Floyd. $4.50.** Discusses in detail various important applications of the polymers belonging to the polyamide resin family and includes a comprehensive section on adhesives. ☐

- **Principles of High Polymer Theory and Practice—A. X. Schmidt and C. A. Marlies. $13.50.** Study of the principles of high-polymer theory and practice, with a section on adhesives, their applications, and mechanisms and factors involved. ☐

- **Recent Advances in Gelatine and Glue Research—G. Stainsby (Editor). $12.00.** Study of Collagen, and its protein gelatine, comprising papers and Proceedings of an International Conference of the British Gelatine and Glue Research Association. ☐

- **Vinyl Resins—Mayo Smith. $5.75.** Surveys applications of vinyl resins with information on their types, properties, chemistry, manufacture and fabrication. Includes information on several types of adhesives in this category. ☐

- **Epoxy Resins—Irving Skeist. $5.50.** A chapter on adhesives is included in this complete study of the entire field of epoxy resins. The author gives formulations, trade names, methods of manufacture and applications. ☐

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Conveyor-Scale Systems. A new, four-page bulletin which tells about the use of conveyor-scale systems for flow-rate control and total thru-put measurement of bulk materials. Designated Bulletin 60, it deals with the use of W-C conveyor-scale systems in conjunction with flat-bed or trough-type conveyor line systems, fixed or variable speed, to provide in-motion weight measurement. The system operation is explained and illustrated with pictorial diagrams. Application and performance data is given on all of the unitized system components. A section of the bulletin describes the application of the conveyor-scale systems to a variety of control functions in processing and formulating operations, including ingredient proportioning. This section also covers the use of the system's continuous thru-put data, expressed in weight per unit of time, for inventory control and cost accounting purposes. *Weighing & Control Components, Inc.* L-289

H-F Epoxy Products. A complete one-source system for solving virtually any surfacing problem through the magic of epoxy is described in this four-page folder. The publication lists 15 epoxy-based products, including the manufacturer's line of Centennial enamels. *Howe & French, Inc.* L-290

Binders and Sand Additives. A new, 12-page booklet describing the manufacturer's complete line of foundry binders and additives for both core and molding sands. Products covered include cereal binders for cores and molds; dry and liquid baked strength core binders; dextrines for greater surface hardness; and additives for sodium silicate CO_2 cores and molds. The profusely illustrated text discusses sand properties imparted by the binders, with detailed information on suggested applications. Use of corn-base additives for promoting peel and collapsibility in CO_2 sand mixes is also described. *Corn Products Sales Co.* L-291

Mylar-Vinyl Laminates. This four-page brochure describes self-adhesive Mylar-vinyl laminates for decorative trim, and incorporates performance specifications and samples. Swatches affixed to the brochure are included as an aid to users of decorative trim materials, and include 17 different types of patterns and finishes in the company's stock line. The manufacturer suggests the use of Mylar vinyl laminates for replacing metal decorative trim on such products as electrical appliances, furniture, industrial equipment, building supplies, boats, automobiles, aircraft and hardware. *Fasson Products.* L-292

Atmospheric Pressure Viscometers. Bulletin No. V-1230 describes viscometers designed for atmospherics pressure applications. The 2-page bulletin contains a diagrammatic sketch of Model M8A viscometer, which has such features as an easy installation, continuous self-cleaning, explosion proof, corrosion resistant, and repeatability and sensitivity. A chart on receivers for viscometer measuring elements covers the uses of recorders 14 by 19 inches and indicators 8 by 8 inches. Another diagram explains the principle of operation of the viscometers. The bulletin also contains a listing of proven industrial uses. *Norcross Corp.* L-293

Aliphatic Amides. A new booklet on high molecular weight aliphatic amides entitled, "Armids." The booklet covers composition and constants, chemical properties and applications of Armid HT, Armid O, Armid C, and Armowax. According to the booklet, these chemicals rank among the more versatile fatty acid derivatives. They are said to be useful in the manufacture of pressure-sensitive tapes, plastics, molded rubber products, protecitve coatings, printing inks, and water repellents. *Armour Industrial Chemical Co.* L-294

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Good Right Hand

Many businessmen and management consultants object to the use of staff assistants or "assistants to," chiefly on the ground that they foul up the chain of command. Even so, the job continues to thrive in government and the Armed Forces, as well as in business. That suggests the assistant must be of some use to his boss, Prof. Thomas L. Whisler of the University of Chicago Graduate School of Business concludes in the September issue of *Administrative Quarterly*. His article is based on a study of the job in business, the military, and federal and city government.

Usually, says Prof. Whisler, the assistant plays the role of information intermediary between his boss and the latter's subordinates or the public. The only exception is city management, a highly professional field, where the chief purpose often is to train the assistant for taking over the top job later. The job of assistant is most likely to appear, Prof. Whisler reports, when the top executive is new, particularly if he's an outsider, and when the top executive runs a large hierarchy with diverse operations and a lot of public contact. Unless the assistant-to is clearly a trainee, his boss' other subordinates are likely to dislike him; his tenure depends on how well he gets along with his boss.

Faster, Faster!

You probably drive faster if your car is air conditioned. Engineers for the Goodyear Tire & Rubber Company say most motorists tend to gauge speeds as much by sound as by their speedometers. When windows are open, road noises and the rush of air emphasize speed, but when a car is air conditioned and the windows closed, the noise and wind is shut out. This lack of sound gives the motorist a feeling of security not necessarily relative to speed, Goodyear points out.

Building and Research

For every dollar spent on research, three dollars is spent eventually on building, a study of the pattern for the past 25 years indicates, according to DuPont. Using 1959 as a yardstick, the $90 million spent on research will eventually require construction costing $270 million.

Community Benefits

The economic impact that a growing business has on a community was dramatically analyzed recently by Canadian National Railways in Montreal. When 100 additional employees were hired, the company figured out, here's what happened to the community structure: 427 more people; 131 more households; 66 more school children; 117 more employees in business other than in manufacturing; 187 more motor vehicle registrations; 393 more telephones; 3 more retail stores; nearly $1 million more retail sales per year.

Canadian National Railways went on to point out that the addition of 100 manufacturing employees resulted in more jobs in other areas: 16 in construction; 5 in utilities; 19 in transportation and communications; 9 in wholesale trade; 29 in retail trade; 7 in finance and insurance; 32 in services.

Packaged Epoxies

The problem of mixing epoxy formulations (sometimes sold as "liquid steel") is becoming a thing of the past. A new one-shot package assures the right proportion every time. Lancaster Chemical Co. has found that it can put both resin and curing agent into a single jar by carefully layering one ingredient on top of the other. A chemical wall forms automatically between the two, preventing mixing and hardening. To use: Just pour the contents through a little screen supplied with the container. Lancaster, incidentally, is licensing its discovery to others.

How True!

Posing the farmer and his college-age son for a picture, the photographer suggested that the boy stand with his hand on his father's shoulder. "If you want it to look natural," said the long-suffering parent, "he could put his hand in my pocket."

Then there is this one: "Yes, I'll give you a job. Sweep out the store."

"But I'm a college graduate."

"Okay, I'll show you how."

in passing

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